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FINAL

Confirmation Sampling and Analysis Plan for the BX Service Station, Facility 736, Site ST-29

Patrick Air Force Base
Florida

Prepared For

Air Force Center for Environmental Excellence
Brooks Air Force Base, Texas

and

45 CES/CEV
Patrick Air Force Base, Florida

June 1998

PARSONS
PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290

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FINAL

CONFIRMATION SAMPLING AND ANALYSIS PLAN FOR THE BX SERVICE STATION, FACILITY 736, SITE ST-29

PATRICK AIR FORCE BASE
FLORIDA

Prepared for:

Air Force Center for Environmental Excellence
Brooks Air Force Base, Texas

and

45 CES/CEV
Patrick Air Force Base, Florida

June 1998

Prepared by:

Parsons Engineering Science, Inc.
1700 Broadway, Suite 900
Denver, Colorado 80290

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AQM01-03-0420

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ACRONYMS AND ABBREVIATIONS

45 CES/CEV	45th Civil Engineering Squadron/Environmental Flight
AFB	Air Force Base
AFCEE	Air Force Center for Environmental Excellence
AS	Air Station
AST	aboveground storage tank
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
BX	Base Exchange
CAR	contamination assessment report
COPC	chemical of potential concern
CPT	cone penetrometer
CW	compliance monitoring well
EP	extraction procedure
ES	Engineering-Science, Inc.
ESE	Environmental Science & Engineering, Inc.
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
HVW	horizontal vent well
ICE	internal combustion engine
LIF	laser-induced fluorescence
LNAPL	light nonaqueous-phase liquid
LTM	long-term monitoring
μg/kg	micrograms per kilogram
μg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MOGAS	motor vehicle gasoline
MP	monitoring point
MTBE	methyl tert-butyl ether
NFA	no further action
NRMRL	National Risk Management Research Laboratory
PAH	polynuclear aromatic hydrocarbon
PAMP	Petroleum Action Management Plan
Parsons ES	Parsons Engineering Science, Inc.
PID	photoionization detector
POC	point of compliance
ppmv	parts per million, volume per volume
QC	quality control
RAP	remedial action plan
SAP	Sampling and Analysis Plan
SVE	soil vapor extraction
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbons

TRPH	total recoverable petroleum hydrocarbons
TVH	total volatile hydrocarbons
TVHA	total volatile hydrocarbon analyzer
USCS	Unified Soil Classification System
USEPA	US Environmental Protection Agency
UST	underground storage tank
VOC	volatile organic compound

SECTION 1

INTRODUCTION

This confirmation sampling and analysis plan (SAP) for the Base Exchange (BX) Service Station, Facility 736, Site ST-29, at Patrick Air Force Base (AFB), Florida has been prepared by Parsons Engineering Science, Inc. (Parsons ES) for submittal to the Florida Department of Environmental Protection (FDEP); the US Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, Texas; and 45th Civil Engineering Squadron/Environmental Flight (45 CES/CEV), Patrick AFB, Florida. The SAP is intended to guide soil sampling at the site to document the effectiveness of remediation of petroleum-hydrocarbon-contaminated soils using *in situ* bioventing. The BX Service Station has been in service since 1954, and is the primary on-Base "gas station" used by military personnel and their families. Petroleum contamination has been identified in site soils and groundwater primarily as a result of leaks in former motor vehicle gasoline (MOGAS) underground storage tanks (USTs) and the associated piping. There is no evidence of mobile light nonaqueous-phase liquid (LNAPL, "free-phase product") at this site.

In 1992, the BX Service Station was selected as a pilot test site for the AFCEE Bioventing Initiative. The purpose of this initiative was to determine if *in situ* bioventing would be a feasible cleanup technology for source area petroleum-contaminated soils within the unsaturated zone. Under the initiative, Parsons ES (formerly Engineering-Science, Inc. [ES, 1993]) installed a pilot-scale bioventing system at the BX Service Station in March 1993, and performed initial pilot testing. Prior to extended pilot testing using air injection bioventing, soil vapor extraction (SVE) was performed for 3 months to reduce high concentrations of total volatile hydrocarbons (TVH) in vadose zone soils. Following SVE and a 96-percent reduction of TVH in extracted soil gas, the system was reconfigured for air injection bioventing and operated for an additional 9 months prior to 1-year testing. Results of the 1-year pilot test demonstrated that SVE and air injection bioventing had effectively treated petroleum-contaminated soils in the area influenced by the pilot-scale system.

In September 1994, the BX Service Station was included in the AFCEE Extended Bioventing project and funded for system expansion (Option 4), extended bioventing system operation followed by soil gas sampling and *in situ* respiration testing (Option 1), and confirmation/closure sampling (Option 2) following sufficient bioventing treatment of site soils. In November 1996, soil gas sampling and respiration testing was performed following approximately 15 months of expanded bioventing system operation, and results indicated that benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations in vadose zone soils had been significantly reduced (Parsons ES, 1997a). An additional 6 months to 1 year of continued system operation was

recommended by Parsons ES and AFCEE, prior to initiating confirmation/closure sampling activities, because of elevated TVH concentrations in soil gas at one location. To date, soils in the vicinity of the original pilot-scale system have benefited from more than 3.5 years of soil venting, and soils influenced by the expanded bioventing system have received more than 2.5 years of treatment. Based on previous sampling results and extended system operation, petroleum hydrocarbon concentrations in vadose zone soils are likely to meet revised FDEP (1997) soil target cleanup levels which appear in Chapter 62-770 of the Florida Administrative Code (FAC), as listed in Section 3 of this SAP.

The objective of the confirmation sampling is to document the effectiveness of *in situ* bioventing for the remediation of petroleum-hydrocarbon contaminated soils. The site is currently under a long-term monitoring status. The proposed confirmation sampling described in Section 4 targets unsaturated and smear zone soils in the vicinity of the current fuel dispensing island and the MOGAS USTs. It is anticipated that soil analytical results will meet FDEP (1997) risk-based criteria for NFA, and that no further soil remediation will be necessary.

This SAP consists of nine sections, including this introduction, and one appendix. Section 2 includes a site description and history, and summaries of previous investigations and remediation activities. Section 3 summarizes cleanup requirements for the BX Service Station. A detailed SAP is presented in Section 4. Analytical results will be presented in a confirmation sampling report, as described in Section 5. Section 6 lists Patrick AFB support requirements, and Section 7 presents the proposed project schedule. Air Force, regulatory, and contractor points of contact are provided in Section 8, and references for this SAP are provided in Section 9. Appendix A provides pertinent groundwater analytical data from previous sampling events.

SECTION 2

SITE DESCRIPTION

2.1 SITE LOCATION AND PROJECT HISTORY

Patrick AFB lies on a long barrier island situated off Florida's east coast, in Brevard County. Patrick AFB is bounded on the east by the Atlantic Ocean and on the west by the Banana River. The City of Cocoa Beach is located immediately north of the Base, and Satellite Beach is directly south. The BX Service Station is located in the north-central section of Patrick AFB (Figure 2.1).

The original service station area is located to the northeast of the existing building (Building 736), as shown on Figure 2.2. The original service station (Site PPOL-2) consisted of four former 5,000-gallon steel USTs that contained MOGAS, a former 4,000-gallon steel UST that contained diesel fuel, and two former dispenser islands and the associated piping. The former dispenser islands were located above the USTs. During a major renovation in 1973, the dispenser islands were removed, the original USTs were abandoned in place, and the original service station area was paved over with asphaltic concrete. New fueling facilities consisting of dispenser islands, five 10,000-gallon fiberglass USTs for MOGAS, and associated piping were installed in their current locations west and southwest of Building 736 (Figure 2.2).

In 1985, a leak was detected in a fiberglass fuel line, and in 1986, one of the 10,000-gallon fiberglass USTs was removed due to leakage. It is estimated that approximately 700 gallons of MOGAS was released into the subsurface as a result of the fuel line and UST leaks (Environmental Science & Engineering, Inc., [ESE], 1991). In February 1992, a 500-gallon UST southeast of Building 736 was removed and replaced with a 1,000-gallon waste oil aboveground storage tank (AST). In 1993, the five abandoned USTs located northeast of Building 736 were excavated and removed along with some excessively contaminated soils (O'Brien & Gere Engineers, Inc. [OB&G], 1995).

2.2 SITE GEOLOGY AND HYDROGEOLOGY

The BX Service Station is characterized by a level ground surface covered primarily with asphalt and concrete pavement. Soils at this site consist of predominantly unconsolidated, poorly to moderately well-sorted, fine- to coarse-grained quartz sand with up to 40-percent shell fragments. This marine sand deposit extends to approximately 25 feet below ground surface (bgs). Figure 2.3 shows the locations of two hydrogeologic cross-sections, which are shown on Figures 2.4 and 2.5.

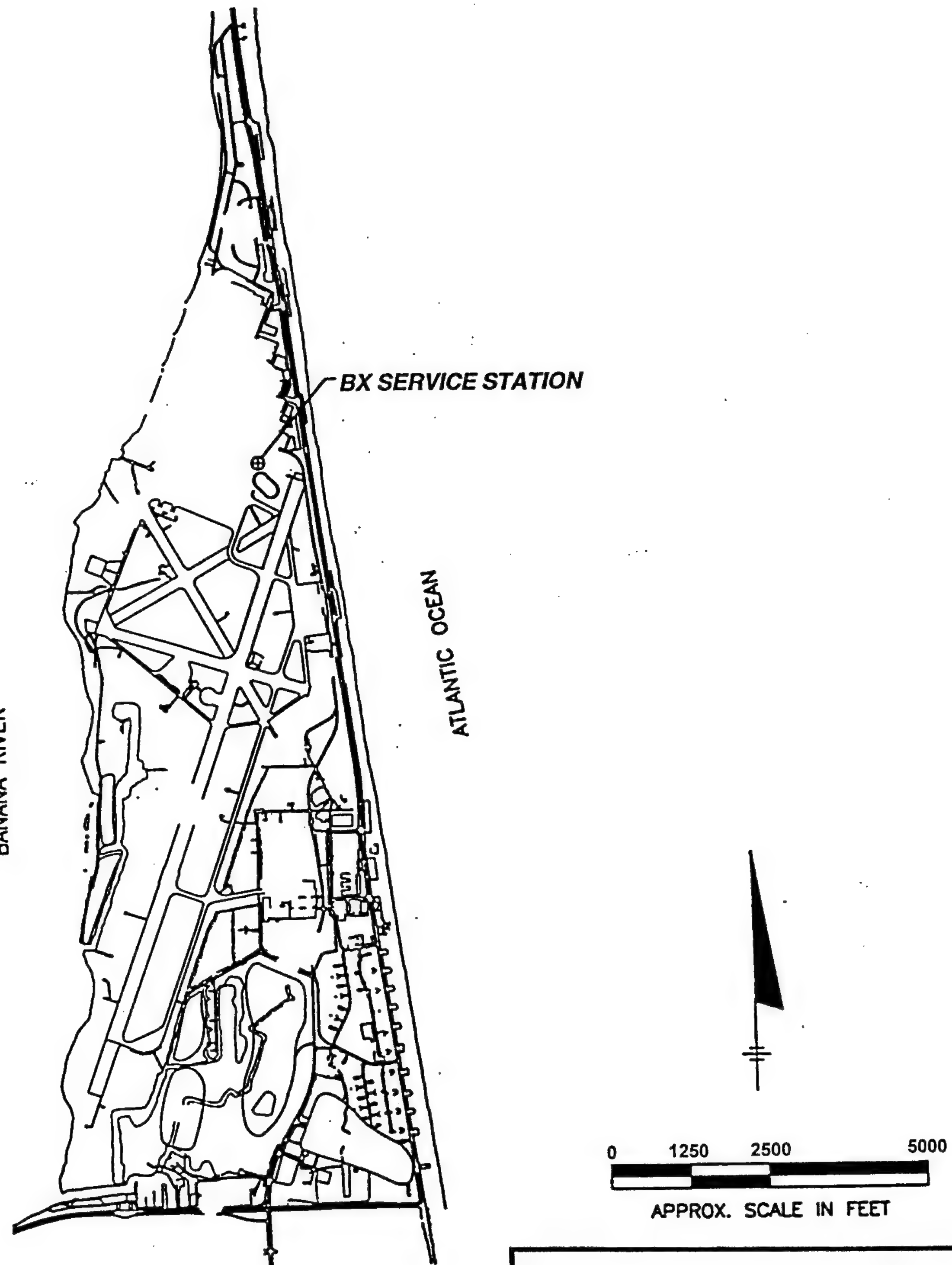

FIGURE 2.1

SITE LOCATION

BX Service Station
Site ST-29
Patrick AFB, Florida

PARSONS
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Denver, Colorado

Source: O'Brien & Gere, 1994.

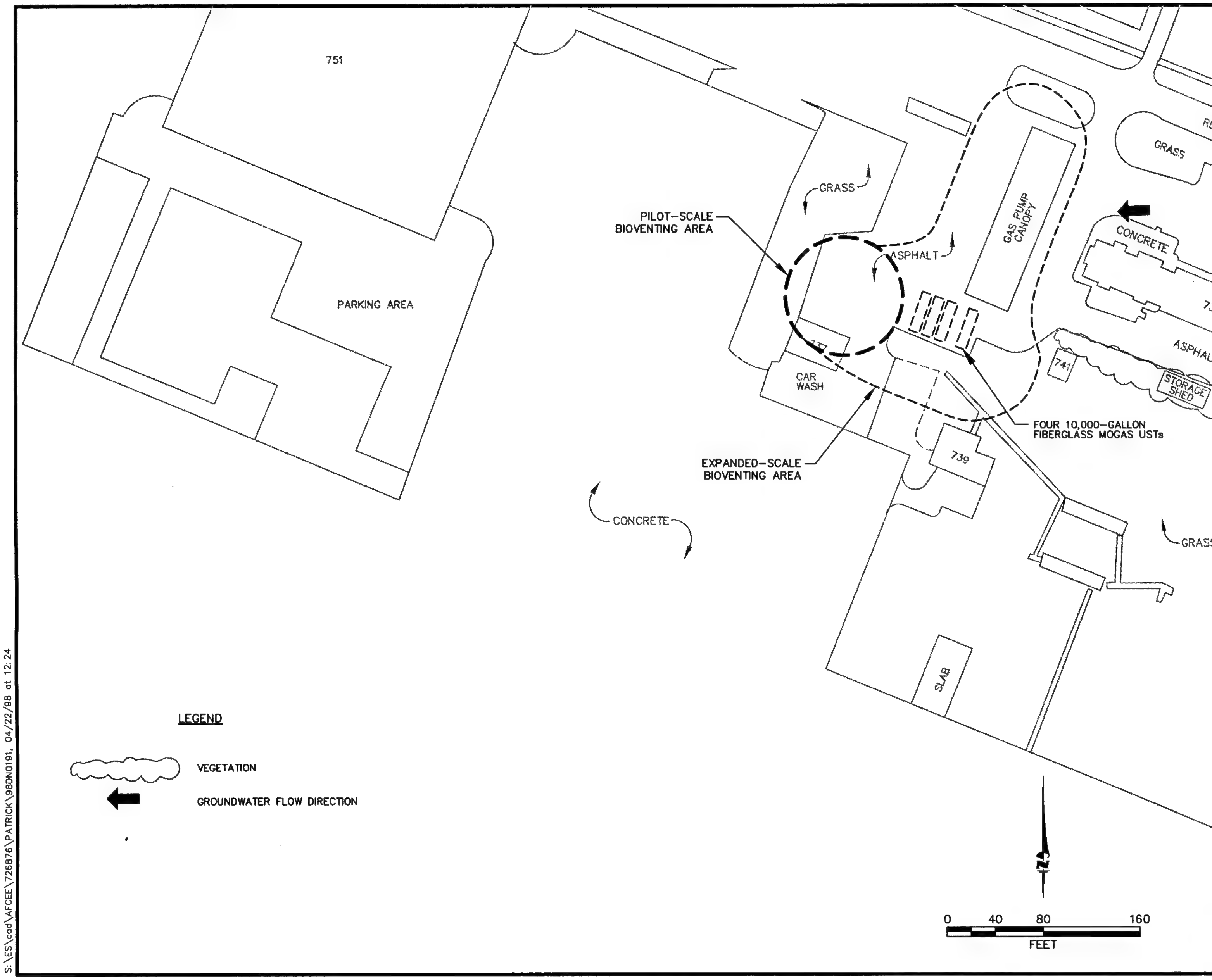

FIGURE 2.2

SITE LAYOUT

BX Service Station
Site ST-29
Patrick AFB, Florida

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Denver, Colorado

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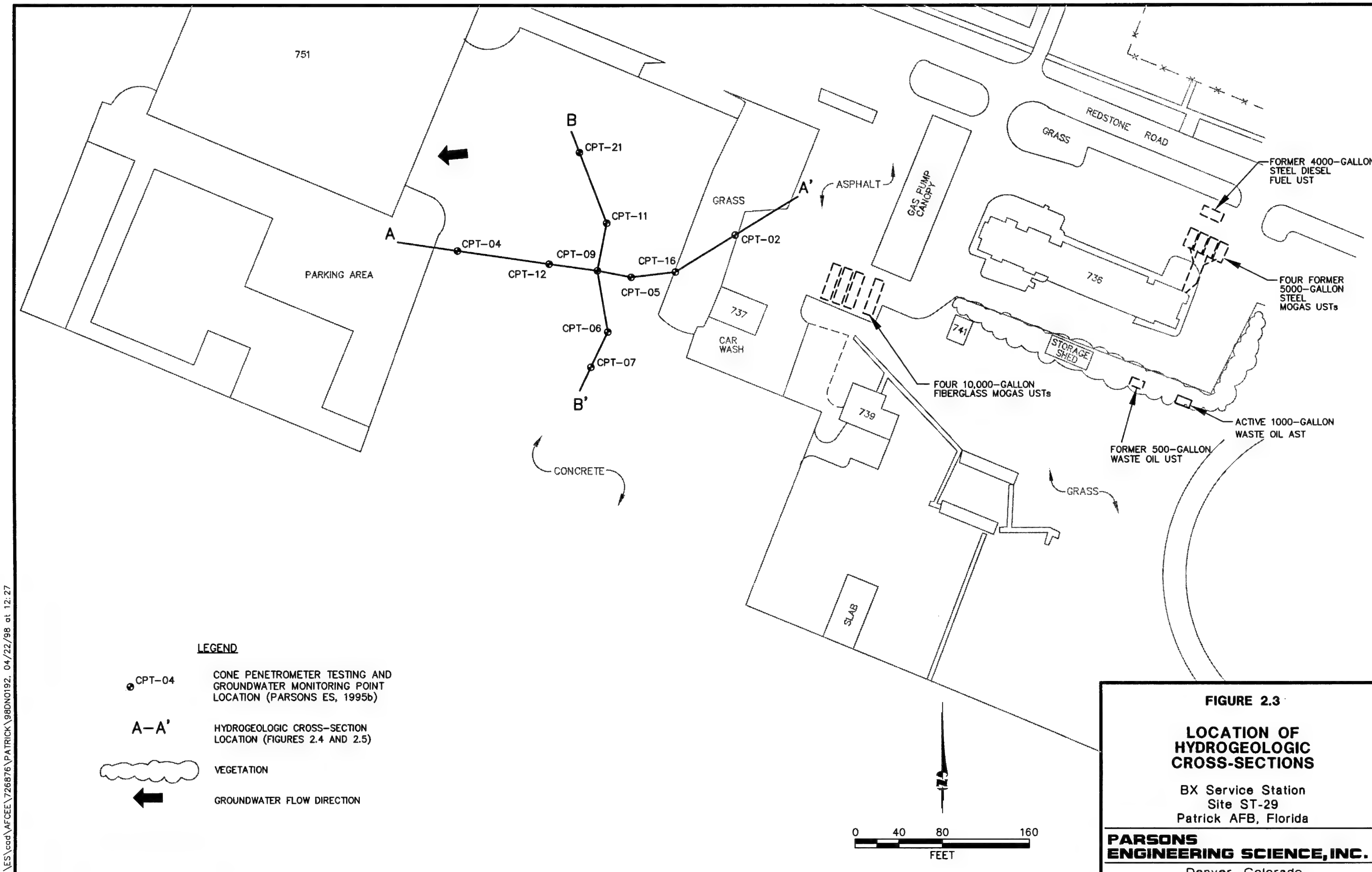

FIGURE 2.3

LOCATION OF HYDROGEOLOGIC CROSS-SECTIONS

BX Service Station
Site ST-29
Patrick AFB, Florida

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Denver, Colorado

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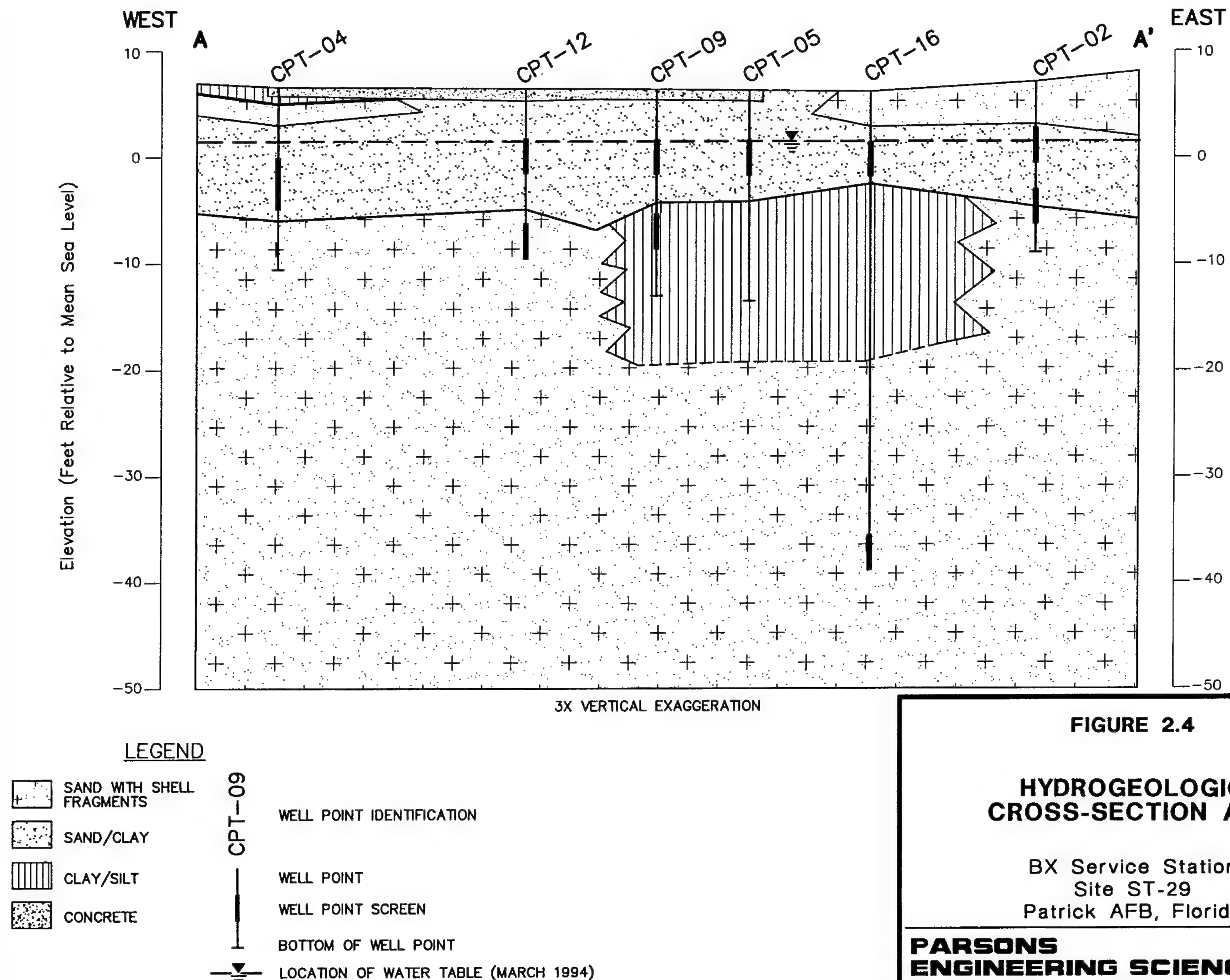

FIGURE 2.4

HYDROGEOLOGIC CROSS-SECTION A-A'

BX Service Station
Site ST-29
Patrick AFB, Florida

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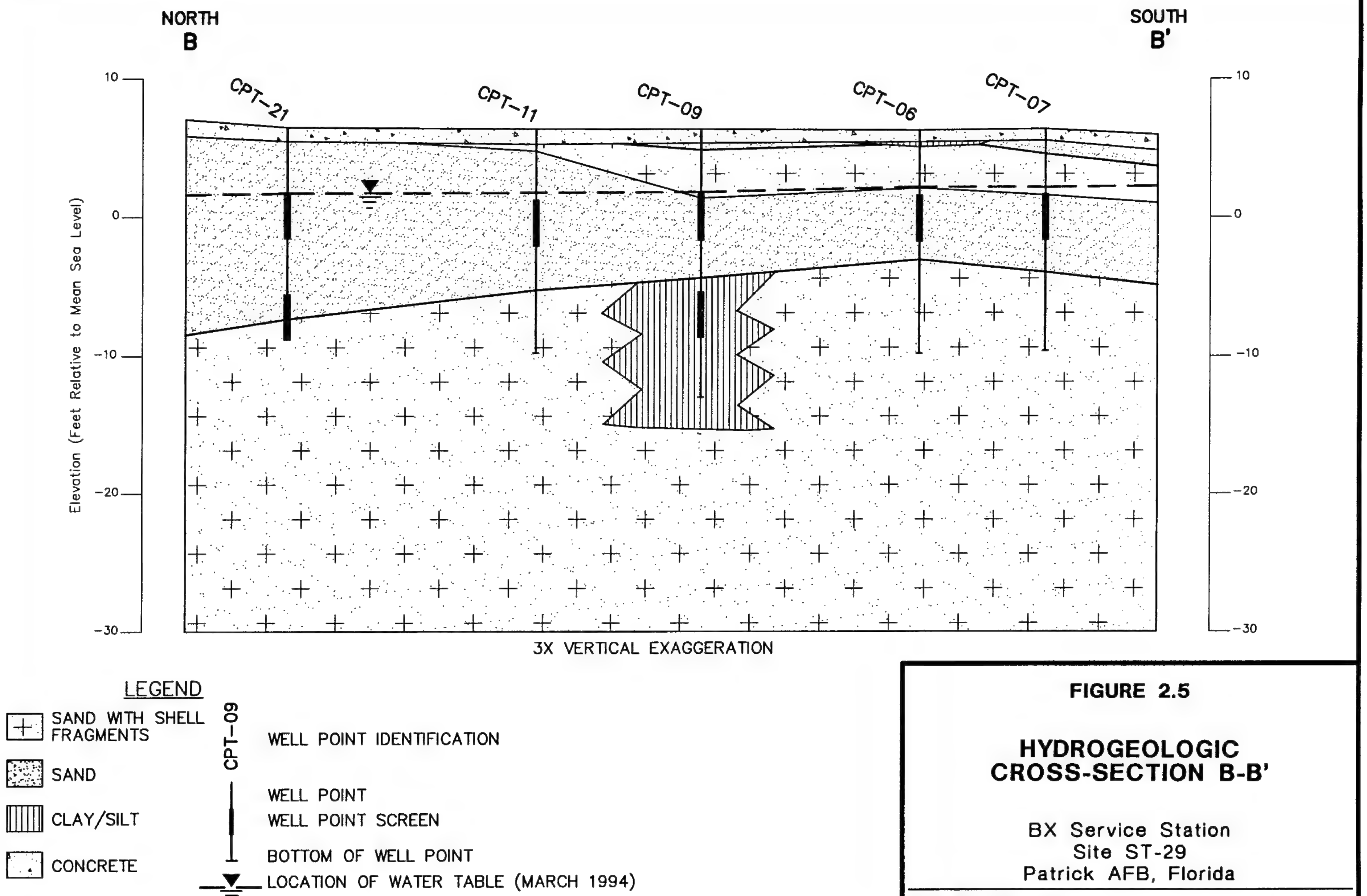

FIGURE 2.5

HYDROGEOLOGIC CROSS-SECTION B-B'

BX Service Station
Site ST-29
Patrick AFB, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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Shallow groundwater at the site is unconfined and typically encountered in the sand at approximately 4 to 6 feet bgs. Historical groundwater elevation data indicate that groundwater flow at the site is generally to the west (ESE, 1991; Parsons ES, 1995b). The horizontal hydraulic gradient at the site ranges from 0.00096 to 0.003 foot per foot (ESE, 1991; OB&G, 1992; Parsons ES, 1995b). The advective groundwater velocity is estimated to be 160 feet per year (Parsons ES, 1995b). Groundwater at Patrick AFB has been designated as Class G-II under State of Florida classifications (ESE, 1991). Class G-II groundwater is acceptable for potable use, with a total dissolved solids content less than 10,000 milligrams per liter [mg/L]). However, shallow groundwater at the site and groundwater at Patrick AFB is not used for potable drinking water. The Base gets its potable water supply from the City of Cocoa (OB&G, 1995).

2.3 PREVIOUS INVESTIGATIONS

2.3.1 1990 Phase II, Stage 2 Investigation by ESE

As a result of the leaking pipe discovered in 1985, and the removal of one 10,000-gallon fiberglass MOGAS UST in 1986, a Phase II, Stage 2 investigation was conducted by ESE (1991) in the western and northwestern areas of the BX Service Station near the active USTs and dispenser island (Figure 2.2). During this investigation, soil samples were collected from eight boreholes (SB-1 through SB-8); five shallow monitoring wells (PPOL2-1 through PPOL 2-5) and one deep monitoring well (PPOL2-6) were installed; and two rounds of groundwater samples were collected. Soil sample results from this investigation are shown in Table 2.1, and groundwater sample results are presented in Appendix A. Soil and groundwater sampling locations are shown on Figure 2.6.

Soil samples were analyzed for total recoverable petroleum hydrocarbons (TRPH), lead, volatile organic compounds (VOCs), and leachable extraction-procedure (EP) toxic metals. Elevated concentrations of TRPH, toluene, ethylbenzene, and xylenes were detected in samples collected from Boreholes SB-2 (adjacent to Building 737), SB-3 (located south of the four active MOGAS USTs), and SB-8 (adjacent to the active dispensing island). The most significant hydrocarbon contamination was evident at SB-2, where TRPH, ethylbenzene, toluene, and xylenes were detected at concentrations of 386 milligrams per kilogram (mg/kg), 100 mg/kg, 38 mg/kg, and 822 mg/kg, respectively.

Groundwater samples were analyzed for TRPH, total and dissolved lead, purgeable halocarbons, and purgeable aromatic compounds. During Round 2 sampling at monitoring well PPOL2-1, which is located directly west of the existing dispenser islands, the fuel additive methyl tert-butyl ether (MTBE) was detected at 151 micrograms per liter (μg/L). At monitoring well PPOL2-3, located southwest of the original service station area, total lead was detected at 0.0221 mg/L, and dissolved lead was detected at 0.0029 mg/L.

2.3.2 Original Service Station Investigation and Remediation

A site characterization of the original service station area (Site PPOL-2) northeast of Building 736 (Figure 2.6) was performed by OB&G (1994 and 1995) from April 1993

TABLE 2.1
ESE AND OB&G SOIL ANALYTICAL RESULTS (1990 AND 1993)
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

Analyte (mg/kg)[a]	Sample Location/(Depth)							
	SB-1	SB-2	SB-3	SB-4	SB-5	SB-6	SB-7	SB-8
ESE (1991)[b]	(NA[c])	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)	(NA)
Lead	5.77	5.44	2.16	4.0	0.970	15.3	1.15	2.85
TRPH	58.3	386	37.3	--[d]	--	57.0	--	43.8
Ethylbenzene	--	100	24	--	--	--	--	32
Toluene	--	38	22	--	--	--	--	7.4
Xylenes	22.3	822	155	--	--	--	--	181

	SB-9		SB-10		SB-11		SB-12		SB-12		SB-13		SB-14		SB-15	
O'Brien & Gere (1994)[e]	(2-4)	(4-6)	(2-4)	(4-6)	(2-4)	(4-6)	(2-4)	(2-4)D[f]	(4-6)	(4-6)D	(2-4)	(4-6)	(2-4)	(4-6)	(2-4)	(4-6)
Volatiles[g]																
Acetone	--	--	--	0.083	--	--	--	--	0.44J[h]	[i]	--	--	--	--	--	--
Benzene	--	--	--	--	--	--	--	--	--		--	--	--	--	--	--
Ethylbenzene	--	--	--	--	--	--	--	0.46	--		--	--	--	--	--	--
Methylene Chloride	--	0.004	--	0.0036	--	0.004J	--	--	--		--	--	0.003J	--	--	--
Toluene	--	--	--	0.0034	--	--	--	--	--		--	--	--	--	--	--
TRPH[j]	62.3	130	39.7	54.0	63	39.3	101		437	514	39.8	34.5	92.5	191	242	752
Semivolatiles[k]																
Fluoranthene	--	--	0.20J	--	--	--	--		--	--	--	--	--	--	--	--
Naphthalene	--	--	--	--	--	--	--		45	36	--	--	--	2.8	5.4	60
1-Methylnaphthalene	--	--	--	--	--	--	--		30	24	--	--	--	4.4	4.4	28
2-Methylnaphthalene	--	--	--	--	--	--	--		59	28	--	--	--	3.6	8.2	62
Phenanthrene	--	--	0.12J	--	--	--	--		--	--	--	--	--	0.072	--	--
Pyrene	--	--	0.14J	--	--	--	--		--	--	--	--	--	--	--	--

[a] mg/kg = milligrams per kilogram.
[b] Soil sample results from 1990 Phase II, Stage 2 investigation.
[c] Sample depths not available.
[d] "--" = not detected, detection limit not available.
[e] Soil sample results from 1993 Petroleum Contamination Assessment, only those analytes that were detected are shown. Soil samples were collected prior to tank and soil excavation.
[f] D = sample replicate.
[g] Analyzed by USEPA Method SW8240.
[h] J = laboratory estimated concentration.
[i] Blank result means sample not analyzed for this parameter.
[j] Analyzed by USEPA Method SW9073.
[k] Analyzed by USEPA Method SW8270.

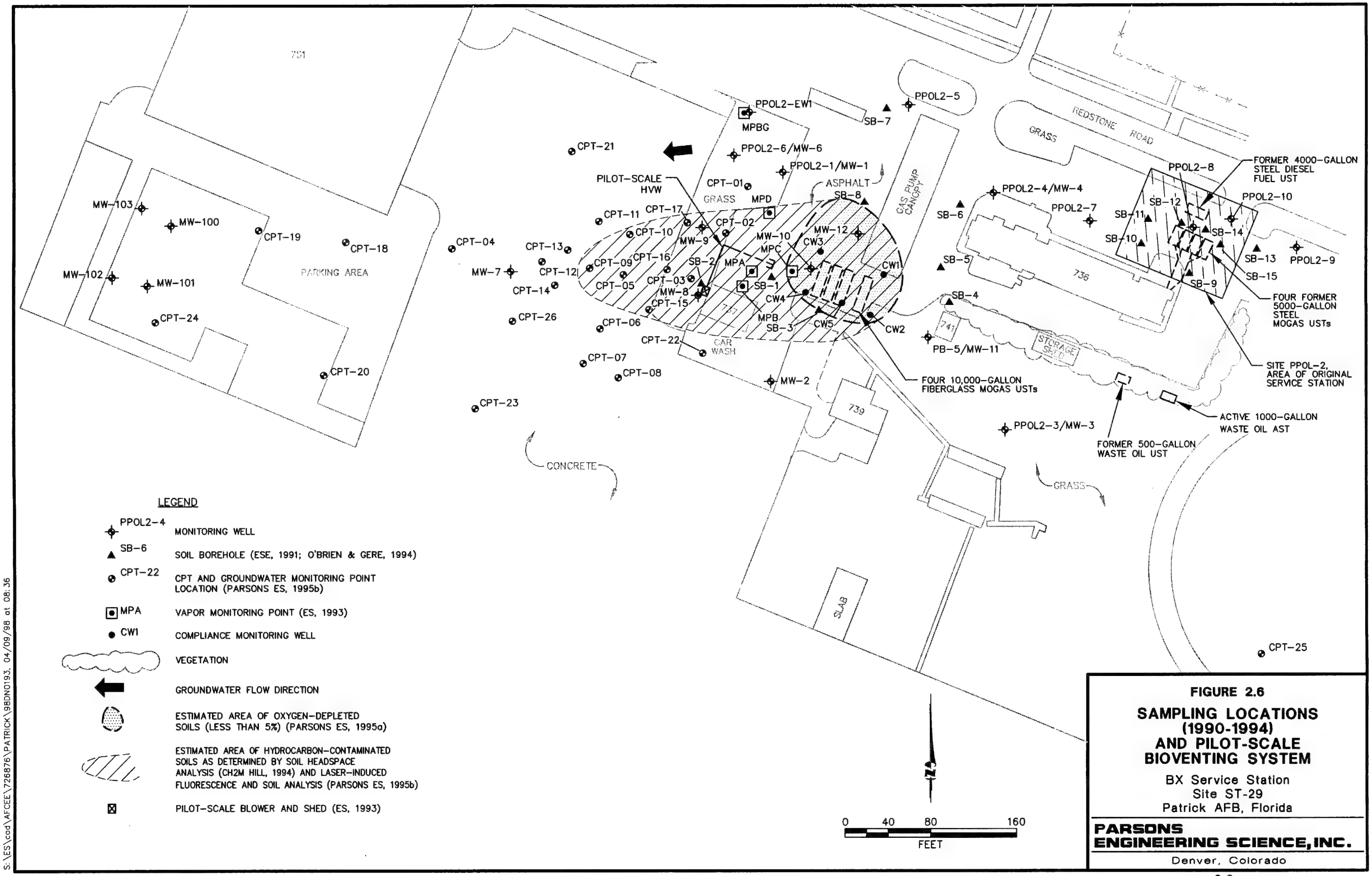

FIGURE 2.6

SAMPLING LOCATIONS (1990-1994) AND PILOT-SCALE BIOVENTING SYSTEM

BX Service Station
Site ST-29
Patrick AFB, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

through July 1994 to evaluate the horizontal and vertical extent of soil contamination, and to assess the potential effects of past releases of MOGAS and/or diesel fuel on shallow groundwater. Results of this study were provided in a Contamination Assessment Report (CAR) for Site PPOL-2 (OB&G, 1995). Soil results are summarized on Table 2.1. Based on soil (Boreholes SB-9 through SB-15) and groundwater (wells PPOL2-4, PPOL2-5, PPOL2-7, PPOL2-8, and PPOL2-9) analytical results from this investigation, petroleum contamination was determined to be most significant in the area of the abandoned USTs and did not extend significantly downgradient. Maximum concentrations of naphthalene (60 mg/kg), 1-methylnaphthalene (28 mg/kg), and 2-methylnaphthalene (62 mg/kg) in soil were detected in the 4- to 6-foot sample interval at SB-15. Elevated concentrations of these polynuclear aromatic hydrocarbons (PAHs) were also detected in the 4- to 6-foot sample interval at SB-12.

Following site investigation activities, the four abandoned MOGAS USTs and one abandoned diesel UST, and approximately 200 tons of excessively contaminated soils were removed between November 30 and December 3, 1993, to eliminate the source of soil and groundwater contamination at the original service station area. Results of the UST closure were documented in a facility engineering report and included as an appendix to the CAR (OB&G, 1995). In January 1996, FDEP (1996) approved an NFA proposal and issued a Site Rehabilitation Completion Order for the original service station area (Site PPOL-2).

2.3.3 March 1994 CH2M Hill Soil Headspace Analysis

In March 1994, a soil headspace analyses investigation was conducted by CH2M Hill (1994) in the vicinity of the active pump islands and USTs west and southwest of Building 736, respectively (Figure 2.6). The soil headspace sampling was performed at 25 locations in accordance with FDEP soil screening guidelines for the headspace analysis method prescribed in FAC, Chapter 17-770.200 (2). The soil vapor VOC headspace readings ranged from 0 to 3,244 parts per million, volume per volume (ppmv) and indicated that soil contamination was most significant immediately adjacent to the pump islands and UST locations.

2.3.4 1994 and 1995 Natural Attenuation Study

As part of a nationwide, multi-site demonstration, Parsons ES (1995b), in conjunction with researchers from the US Environmental Protection Agency (USEPA) National Risk Management Research Laboratory (NRMRL; formerly Robert S. Kerr Environmental Research Laboratory), was retained by AFCEE to conduct site characterization and groundwater modeling at the BX Service Station (Site ST-29) to evaluate the effectiveness of natural attenuation of dissolved fuel contaminants. To support the study, site characterization data, including soil and groundwater sampling and aquifer testing, were collected in March 1994 (by Parsons ES and NRMRL), March 1995 (NRMRL), and May 1995 (CH2M Hill). Cone penetrometer testing (CPT) was conducted to collect stratigraphic information and soil samples in the vicinity of the active pump islands and USTs and downgradient from the site. Groundwater samples were collected at monitoring points installed in CPT boreholes,

and at previously installed monitoring wells. Soil and groundwater sampling locations are shown on Figure 2.6.

Soil samples collected in March 1994 were analyzed for BTEX, total petroleum hydrocarbons (TPH), trimethylbenzene isomers, and total organic carbon. Soil BTEX and TPH data are included in Table 2.2. The highest concentrations of total BTEX and TPH observed during this investigation were from samples collected near the water table (e.g., 5.5 to 6.5 feet bgs) downgradient from the active USTs and pump islands. A total BTEX concentration of 1,236 mg/kg and a TPH concentration of 17,100 mg/kg were detected in the sample collected 6 feet bgs at CPT-02. At CPT-03, a TPH concentration of 11,700 mg/kg was detected in the sample collected 5.5 feet bgs, and a total BTEX concentration of 975 mg/kg was detected in the 6.5-foot bgs soil sample. Total BTEX concentrations are generally an order of magnitude lower in samples collected 1 to 2 feet above or below these capillary fringe samples. During this investigation, the downgradient extent of smear zone hydrocarbon contamination was estimated to be approximately 220 feet downgradient from the source area (Figure 2.6), where total BTEX and TPH concentrations of 0.0989 mg/kg and 2,740 mg/kg, respectively, were detected in the 5-foot-bgs sample from CPT-09.

Groundwater samples collected in March 1994 (by Parsons ES and NRMRL), in March 1995 (by NRMRL), and in May 1995 (by CH2M Hill) confirmed the presence of fuel-hydrocarbon contamination in the shallow saturated zone in the vicinity of the BX Service Station and extending downgradient to an area just south of Building 751 (Figure 2.6). Dissolved BTEX contamination has migrated west of the active USTs and pump islands in the direction of groundwater flow; however, data collected between March 1994 and March/May 1995 indicate that natural chemical attenuation processes have been effective in preventing further downgradient migration of the dissolved BTEX plume. Groundwater contaminant and geochemical data indicate that biodegradation is reducing dissolved contaminant mass, and the BTEX plume shrank in both the longitudinal and lateral directions between March 1994 and March/May 1995 (Parsons ES, 1995b). Tables and figures summarizing groundwater contaminant data and distribution based on these sampling events are provided in Appendix A.

The results of the study suggest that natural attenuation of dissolved BTEX compounds is occurring at sufficient rates to reduce concentrations below regulatory guidelines before potential downgradient receptors could be adversely affected. The study recommended the use of long-term monitoring (LTM) wells and point-of-compliance (POC) monitoring wells to monitor the long-term migration and degradation of the dissolved BTEX plume (Parsons ES, 1995b). The study also recommended continued bioventing until source area contamination in site soils was sufficiently reduced.

2.4 PILOT-SCALE AND EXPANDED-SCALE BIOVENTING

As part of the AFCEE Bioventing Initiative, ES (1993) installed a pilot-scale bioventing system at the BX Service Station in March 1993 to assess the potential for air injection bioventing to remediate the hydrocarbon contamination identified in vadose zone soils. The primary objectives of the pilot test were: 1) to assess the potential for

TABLE 2.2
PARSONS ES SOIL ANALYTICAL RESULTS (1993-1995)
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

Sampling Event/ Sample Location	Depth (ft bgs)[b/]	Analyte[a/] TPH (mg/kg)[c/]	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
March 1994 Natural Attenuation Study[d/]						
CPT-02-A17	4	ND[e/]	<0.02[f/]	<0.02	0.0345	0.1085
CPT-02-A18	5	140	0.197	0.0605	0.514	3.119
CPT-02-A19	6	17,100	6.99	8.08	191	1,030
CPT-02-A20	6.45	1,660	0.68	0.345	16.1	84.1
CPT-02-A21	7	289	0.339	0.106	2.26	12.42
CPT-03-A22	3	20.9	0.164	0.0142	0.21	1.019
CPT-03-A23	4.5	0.2	ND	<0.02	0.00838	0.0418
CPT-03-A24	5.5	11,700	<0.02	0.462	<0.02	171.3
CPT-03-A25	6.5	9,300	2.33	29.5	120	823
CPT-03-A26	7	287	0.366	0.532	2.02	15.46
CPT-05-A1	3.5	ND	<0.02	<0.02	<0.02	<0.02
CPT-05-A2	4.5	ND	<0.02	<0.02	<0.02	<0.02
CPT-05-A3	5	ND	<0.02	<0.02	<0.02	0.00725
CPT-05-A4	5.5	ND	<0.02	<0.02	<0.02	<0.02
CPT-09-A4	2.5	2	<0.02	<0.02	ND	<0.02
CPT-09-A5	4.5	47.1	<0.02	<0.02	<0.02	<0.02
CPT-09-A6	5	2,740	<0.02	0.034	<0.02	0.0649
CPT-09-A7	6	15.2	<0.02	<0.02	<0.02	<0.02
CPT-13	5.5	ND	<0.02	<0.02	<0.02	<0.02
CPT-15-A8	3	ND	<0.02	<0.02	ND	<0.02
CPT-15-A9	4	0.01	<0.02	<0.02	ND	<0.02
CPT-15-A10	5	526	<0.02	0.012	0.00978	0.0226
CPT-15-A11	5.5	ND	ND	ND	<0.02	<0.02
CPT-16-A1	4.5	0.04	0.00752	0.00761	<0.02	<0.02
CPT-16-A2	6	ND	ND	<0.02	ND	<0.02
CPT-17-A12	2	ND	ND	<0.02	<0.02	<0.02
CPT-17-A13	3	ND	ND	<0.02	ND	<0.02
CPT-17-A14	4	ND	ND	<0.02	<0.02	0.00779
CPT-17-A15	5	ND	ND	<0.02	ND	<0.02

TABLE 2.2 (Continued)
PARSONS ES SOIL ANALYTICAL RESULTS (1993-1995)
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

		Analyte[a]				
Sampling Event/ Sample Location	Depth (ft bgs)[b]	TRPH (mg/kg)[c]	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Xylenes (mg/kg)
Pilot-Scale Bioventing March 1993[g]						
HVW-2	4.5	2,730	< 14[h]	54	260	2,600
MPA	3.5	11	< 6.2	23	320	140
MPC	3.5	60	< 0.31	< 0.36	< 0.26	5.7
December 1994[i]						
HVW-2	4.5	81.9	< 0.05	< 0.05	< 0.05	< 0.099
MPA	3.5	50.8	< 0.049	< 0.049	< 0.049	< 0.098
MPC	3.5	57.6	0.13	0.15	0.16	0.49
Expanded-Scale Bioventing July 1995[j]						
MPE	3.5	743	0.075	< 0.05	20	160
MPF	3.5	767	0.47	0.57	7.4	9.0
CW2	3.5	13.3	< 0.05	< 0.05	< 0.05	< 0.13

[a] For natural attenuation study, total petroleum hydrocarbons (TPH) quantified with a JP-4 jet fuel standard. For pilot-scale and expanded-scale bioventing, total recoverable petroleum hydrocarbons (TRPH) analyzed by USEPA Method 418.1; benzene, toluene, ethylbenzene, and total xylenes analyzed by USEPA Method SW8020.

[b] ft bgs = feet below ground surface.

[c] mg/kg = milligrams per kilogram.

[d] Parsons ES, 1995a.

[e] ND = not detected and detection limit not available.

[f] < = below limit of quantitation shown for natural attenuation study results.

[g] ES, 1993. Soil samples collected prior to pilot-scale bioventing system startup.

[h] < = analyte concentration in sample was less than the method detection limit shown for bioventing results.

[i] Soil samples collected following approximately 3 months of soil vapor extraction and 9 months of pilot-scale bioventing system operation.

[j] Soil samples collected during full-scale bioventing system installation.

supplying oxygen throughout the contaminated soil profile; 2) to determine the rate at which indigenous microorganisms would degrade petroleum hydrocarbons when stimulated by oxygen-rich soil gas at this site; and 3) to evaluate the potential for sustaining these rates of biodegradation until hydrocarbon contamination is remediated below regulatory approved standards (ES, 1993).

The pilot test location and system configuration were based on results of a soil gas survey performed by ES in January 1993 in the vicinity of SB-2. The soil gas survey indicated TVH concentrations exceeding 10,000 ppmv and depleted oxygen conditions in soils immediately north of the car wash, Building 737 (ES, 1993). The pilot-scale bioventing system consisted of one horizontal vent well (HVW-2), five vapor monitoring points (MPA, MPB, MPC, MPD, and MPBG), a 1-horsepower regenerative blower, blower piping and gauges, and a weatherproof blower shed (see Figure 2.6). The HVW was installed at the site at a depth of approximately 4 feet bgs because of the relatively shallow water table. At each of the MPs, a single screened interval was placed from 3.0 to 3.5 feet bgs. During installation and testing of the pilot-scale system, soil and soil gas sampling, and respiration and soil-to-air permeability testing were performed. Based on results of the oxygen influence and air permeability testing, the long-term radius of oxygen influence around the HVW was expected to exceed 37 feet. A detailed description of the pilot-scale bioventing system design and initial testing results are provided in the Draft Interim Pilot Test Results Report (ES, 1993).

Prior to extended operation of the pilot-scale air injection bioventing system, SVE was performed at the BX Service Station site to reduce the potential for uncontrolled VOC vapor migration and discharge to the atmosphere. Soil gas samples collected during the January 1993 soil gas survey and initial soil gas samples collected following pilot-scale bioventing system installation indicated significant concentrations of TVH in soil gas at the site, and the need for a short period of SVE prior to air injection bioventing. The SVE system utilized a modified internal combustion engine (ICE) for the removal and destruction of hydrocarbon vapors extracted from fuel-contaminated soils at the site (AFCEE, 1994). The SVE system was operated from October 18, 1993 through January 14, 1994, when the blower was reconfigured for air injection bioventing. Startup of the bioventing system immediately followed SVE system shutdown and continued until November 1994. One-year respiration testing and soil gas sampling was performed in December 1994, following 1 month of system shutdown to allow equilibrium conditions to develop in site soils, for comparison to initial results. Following the 1-year testing event, the system was started and reoptimized for continuous air injection.

In December 1994, during the collection of 1-year data for the pilot-scale system, Parsons ES performed a soil gas survey in the vicinity of the active pump islands and USTs to supplement the March 1994 CH2M Hill investigation (Section 2.3.3). The results from this survey indicated that the extent of remaining unsaturated soil contamination was localized around the active pump islands and USTs west and southwest of Building 736, and that soil gas oxygen levels in this area were depleted (less than 5 percent). The estimated area of oxygen depletion based on this survey is shown on Figure 2.6.

Based on favorable 1-year testing results for the pilot-scale bioventing system, and the presence of contaminated soil outside the effective treatment area of HVW-2, the BX Service Station site was added to the AFCEE Extended Bioventing Project (Contract No. F41624-92-D-8036, Order 17, awarded by AFCEE to Parsons ES on 30 September 1994). Under the extended bioventing project, funding was allocated for bioventing system expansion at the site (Option 4); for an additional year of system operation and testing (Option 1); and for confirmation/closure soil sampling (Option 2), following sufficient remediation of petroleum-hydrocarbon-contaminated soils.

In preparation for bioventing system expansion, Parsons ES (1995a) developed an Initial Remedial Action Plan and performed a supplemental soil headspace survey in May 1995. The survey further delineated the soils to be remediated through bioventing system expansion. Following Patrick AFB, AFCEE, and FDEP approval of the Initial Remedial Action Plan, the expanded full-scale bioventing system was installed in July 1995 in the vicinity of the active pump islands and USTs. The expanded-scale system consists of two additional HVWs (HVW-1 and HVW-3), five additional MPs (MPE, MPF, MPG, MPH, and MPI), and a new blower system. A layout of the expanded-scale bioventing system is presented on Figure 2.7.

Expanded-scale system operation began on July 12, 1995. Option 1 soil gas sampling and respiration testing was performed in early November 1996, following 1 month of system shutdown to allow equilibrium conditions to develop in site soils and to allow comparison to initial and 1-year results. Results of the Option 1 testing event were presented in a Parsons ES (1997a) letter report to AFCEE and Patrick AFB. The expanded-scale bioventing system was restarted following Option 1 testing. In March 1997, Parsons ES revisited the site to perform a systems maintenance check. Site measurements demonstrated that the entire area designated for treatment was receiving oxygen as a result of expanded-scale bioventing system operation (Parsons ES, 1997b).

2.4.1 Soil Sampling Results

Soil sampling by Parsons ES was conducted at the BX Service Station site during installation of the pilot-scale bioventing system (March 1993), after 12 months of SVE/pilot-scale air injection bioventing (December 1994), and during installation of the full-scale bioventing system (July 1995). A summary of the pilot-scale and expanded-scale soil analytical results is provided in Table 2.2.

The TRPH concentrations in soils sampled from the immediate vicinity of the pilot-scale horizontal vent well decreased 1 to 2 orders of magnitude between March 1993 and December 1994. TRPH concentrations at MPA and MPC showed little contamination prior to SVE and pilot-scale bioventing, and remained low at the 1-year sampling event. BTEX concentrations in soils at HVW-2 and MPA decreased 3 to 4 orders of magnitude to nondetect levels as a result of SVE and air injection bioventing. Lesser decreases in BTEX soil concentrations were evident at MPC.

Soil samples also were collected from MPE, MPF, and compliance monitoring well CW2 (Figure 2.7) in July 1995 during bioventing system expansion. TRPH and BTEX concentrations in soils collected from MPE and MPF indicated these areas were moderately impacted by fuel hydrocarbon contamination. Significant contamination

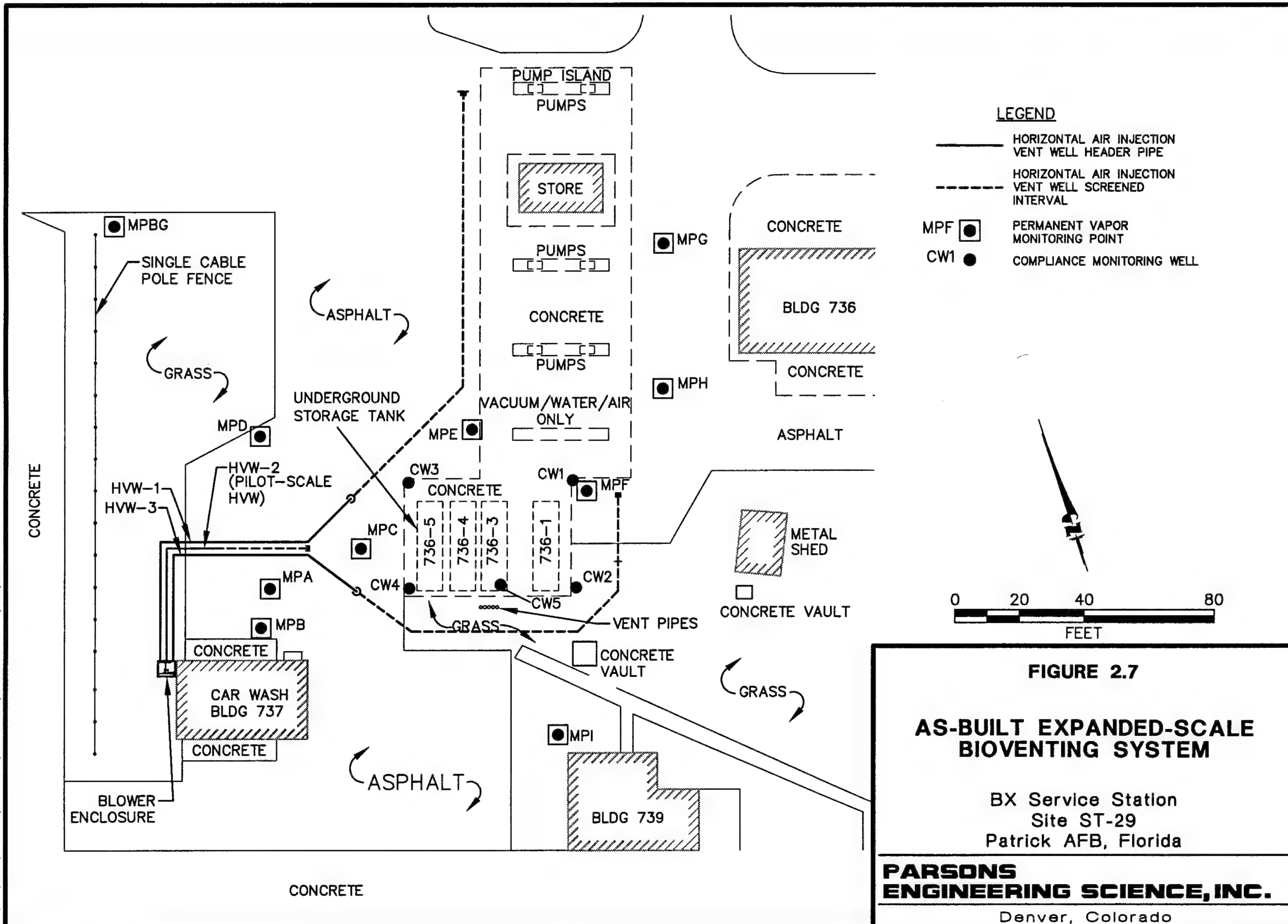

FIGURE 2.7

AS-BUILT EXPANDED-SCALE BIOVENTING SYSTEM

BX Service Station
Site ST-29
Patrick AFB, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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was not evident at CW2. Although no soil sampling was performed by Parsons ES following 1 year of full-scale system operation, based on measured reductions in soil gas TVH and BTEX concentrations and decreased *in situ* respiration rates, significant reductions in soil TRPH and BTEX concentrations appear to have occurred as the result of expanded-scale bioventing system operation.

2.4.2 Soil Gas Sampling Results

Soil gas sampling was performed in March 1993 prior to SVE/bioventing system startup (in October 1993), in December 1994 following 3 months of SVE and 9 months of air injection bioventing system operation, in July 1995 prior to expanded-scale bioventing system startup, and in November 1996 following 15 months of expanded-scale bioventing system operation. Soil gas samples were collected from each MP and field-screened to assess soil gas concentrations of oxygen, carbon dioxide, and TVH. Results presented in Table 2.3 indicate that static oxygen concentrations in soil gas have generally increased with continued bioventing at the site. During the November 1996 sampling event, soils at MPF had not experienced a measurable increase in soil gas oxygen concentration, which suggested ongoing aerobic activity associated with relatively greater residual hydrocarbon contamination (Table 2.2).

Initial, 1-year, and 3-year soil gas samples also were collected at selected locations for laboratory analysis (Table 2.3). For all three sampling events, samples were sent to the Air Toxics, Ltd. laboratory in Folsom, California and analyzed for TVH and BTEX using USEPA Method TO-3. Comparison of 1-year and 3-year soil gas results demonstrated substantial reductions in TVH and BTEX concentrations compared to initial values. With the exception of total xylenes at MPE, BTEX concentrations had been reduced to less than 1.0 ppmv at all locations sampled during the November 1996 sampling event. During the initial 3 years of soil venting system operation, TVH concentrations were reduced from between 38,000 and 100,000 ppmv to less than 1.0 ppmv in the pilot-scale area (MPB and MPC). Soil gas results from MPE and MPF, installed as part of the expanded-scale bioventing system, showed TVH concentrations were reduced between 1 and 3 orders of magnitude following the first year of expanded-scale system operation.

With the exception of results from MPF, located on the east side of the active fiberglass USTs (Figure 2.7), field and analytical soil gas results from the November 1996 sampling event strongly suggested nearly complete remediation of hydrocarbon contaminants in soils at the BX Service Station site. Results of the March 1997 maintenance check demonstrated that MPF was receiving adequate oxygen (20.3 percent) for continued aerobic biodegradation of petroleum hydrocarbon contaminants in this source area (Parsons ES, 1997b).

2.4.3 Respiration Test Results

Respiration and fuel biodegradation rates for the first 3 years of soil venting are shown in Table 2.4. During each testing period, observed rates of oxygen utilization (*in situ* respiration) were used to estimate aerobic fuel biodegradation rates in site soils. Results of the November 1996 Option 1 testing event demonstrated that *in situ* respiration and fuel biodegradation rates have generally decreased with continued

TABLE 2.3
SOIL GAS FIELD AND ANALYTICAL RESULTS
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

		Field Screening Data			Analytical Data[d]				
Sampling Location[a]	Sampling Event	Oxygen (percent)	Carbon Dioxide (percent)	TVH[b] (ppmv)[c]	TVH (ppmv)	Benzene (ppmv)	Toluene (ppmv)	Ethylbenzene (ppmv)	Xylenes (ppmv)
PILOT-SCALE BIOVENTING SYSTEM AREA									
HVW-4[e]	Initial (3/93)	0.0	15.0	> 20,000[f]	47,000	< 2.2[g]	15	14	200
	1-Year (12/94)	---[h]	---	---	---	---	---	---	---
	3-Year (11/96)	---	---	---	---	---	---	---	---
MPA-3.5	Initial (3/93)	0.0	14.3	> 20,000	100,000	< 5.3	110	46	310
	1-Year (12/94)	11.8	5.0	230	6.9	0.033	0.003	0.008	0.46
	1.5-Year (7/95)	11.0	4.8	50	---	---	---	---	---
	3-Year (11/96)	10.7	5.1	156	---	---	---	---	---
MPB-3.5	Initial (3/93)	0.0	13.6	> 20,000	---	---	---	---	---
	1-Year (12/94)	3.5	9.8	560	---	---	---	---	---
	1.5-Year (7/95)	4.2	7.8	50	---	---	---	---	---
	3-Year (11/96)	7.5	6.6	340	0.17	< 0.002	< 0.002	< 0.002	< 0.002
MPC-3.5	Initial (3/93)	0.0	15.2	> 20,000	38,000	< 2.1	8.3	12	83
	1-Year (12/94)	14.2	4.2	200	1.7	0.02	< 0.002	< 0.002	< 0.002
	1.5-Year (7/95)	11.3	6.0	40	---	---	---	---	---
	3-Year (11/96)	12.5	5.0	164	0.13	< 0.002	< 0.002	< 0.002	< 0.002
MPD-3.5	Initial (3/93)	15.9	2.8	260	---	---	---	---	---
	1-Year (12/94)	---	---	---	---	---	---	---	---
	1.5-Year (7/95)	19.1	1.1	20	---	---	---	---	---
	3-Year (11/96)	19.0	1.7	92	---	---	---	---	---
FULL-SCALE BIOVENTING SYSTEM AREA									
MPE-3.5	Initial (7/95)	0.0	18.0	19,000	27,140	88	130	240	1,200
	1-Year (11/96)	8.2	6.0	196	9.9	< 0.005	0.11M[i]	0.24	1.6
MPF-3.5	Initial (7/95)	0.0	17.5	>20,000	27,500	98	67	300	210
	1-Year (11/96)	0.0	10.4	1,020	2,200	0.16	0.53	0.39	0.65
MPG-3.5	Initial (7/95)	15.8	4.0	10	---	---	---	---	---
	1-Year (11/96)	18.9	1.6	80	---	---	---	---	---
MPH-3.5	Initial (7/95)	9.8	8.0	20	---	---	---	---	---
	1-Year (11/96)	17.6	2.0	88	1.0	< 0.002	< 0.002	< 0.002	< 0.002
MPI-3.5	Initial (7/95)	19.5	0.8	10	---	---	---	---	---
	1-Year (11/96)	20.0	0.7	36	---	---	---	---	---
CW2-4[j]	Initial (7/95)	---	---	---	2.29	< 0.002	0.070	< 0.002	< 0.002
	1-Year (11/96)	---	---	---	---	---	---	---	---

[a] Sampling location identifies the sampled monitoring point and depth in feet below ground surface.
[b] TVH = total volatile hydrocarbons.
[c] ppmv = parts per million, volume per volume.
[d] Soil gas analyses performed using USEPA Method TO-3.
[e] The pilot-scale horizontal vent well is designated HVW-2 on Figure 2.7.
[f] > = measurement exceeded maximum reading for GasTech® Trace-Techtor Hydrocarbon Analyzer.
[g] < = analyte concentration was less than the method detection limit shown.
[h] --- = not analyzed.
[i] M= laboratory reported value may be biased due to apparent matrix interferences.
[j] Compliance monitoring well 2 (CW2) is screened from approximately 3 to 13 feet below ground surface. The middle of the effective screened interval for soil gas sampling was approximately 4 feet below ground surface during the 7/95 sampling event.

TABLE 2.4
RESPIRATION AND FUEL BIODEGRADATION RATES
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

Testing Location-Depth	Initial (March 1993)		6-Month (May 1994)[a]		1-Year (Dec. 1994)		3-Year (Nov. 1996)	
	Respiration Rate (% O_2/hour)	Degradation Rate (mg/kg/year)[b]	Respiration Rate (% O_2/hour)	Degradation Rate[c] (mg/kg/year)	Respiration Rate (% O_2/hour)	Degradation Rate (mg/kg/year)	Respiration Rate (% O_2/hour)	Degradation Rate[d] (mg/kg/year)
MPA-3.5	0.17	940	0.19	970	0.029	130	NM[e]	NC[f]
MPB-3.5	0.15	840	0.27	1,400	0.035	150	0.084	380
MPC-3.5	0.16	970	0.16	850	0.020	92	NM	NC
MPE-3.5	-----[g]	-----	-----	-----	-----	-----	0.066	290
MPF-3.5	-----	-----	-----	-----	-----	-----	0.12	540

[a] Initial bioventing pilot test occurred in March 1993, but SVE/air injection bioventing system operation did not begin until October 18, 1993.
[b] Milligrams of hydrocarbons per kilogram of soil per year.
[c] 6-month degradation rates based on average soil moisture results for initial and 1-year soil sampling events.
[d] 3-year degradation rates based on average soil moisture result from December 1994 soil sampling event.
[e] NM = not measured.
[f] NC = not calculated.
[g] ----- = not analyzed; MPE and MPF were not installed until July 1995.

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bioventing at the site. Respiration and fuel biodegradation rates at MPF were somewhat elevated during the Option 1 testing event due to the remaining hydrocarbon contamination present at this location.

2.4.4 Recommendations Following Option 1 Testing

Because of the relatively high TVH concentrations in soil gas at MPF, Parsons ES recommended continued expanded-scale bioventing system operation at the site for an additional 6 months to 1 year prior to initiating Option 2 confirmation sampling activities. Based on soil sampling results and soil gas and respiration results obtained following approximately 3 years of SVE and pilot- and expanded-scale bioventing system operation, the majority of the soils at the site are likely to have been sufficiently remediated to meet FDEP (1997) criteria outlined in FAC, Chapter 62-770. Continued operation of the expanded-scale bioventing system since November 1996 has further reduced petroleum hydrocarbon contamination in site soils, including soils near MPF. It is anticipated that soil analytical results will meet FDEP risk-based criteria for NFA, or groundwater monitoring only, and no further soil remediation will be necessary.

2.5 NATURAL ATTENUATION UPDATE SAMPLING

In March 1998, personnel from NRMRL performed an additional round of groundwater sampling at Site ST-29 to evaluate the progression of dissolved fuel contaminant natural attenuation. At the time this SAP was prepared, monitoring results from this sampling event were not available. These groundwater sampling results will be provided in a separate report generated as part of the AFCEE natural attenuation project.

SECTION 3

SITE CLEANUP REQUIREMENTS

3.1 SITE CHARACTERIZATION REQUIREMENTS

The objective of the confirmation sampling is to demonstrate that contaminant levels in soils contaminated by previous leaks of MOGAS from the fiberglass fuel line and UST located near the active fuel facilities west and southwest of Building 736 meet FDEP (1997) risk-based criteria for NFA, or groundwater monitoring only, and that no further soil remediation will be necessary. This SAP targets unsaturated and smear-zone soils in the immediate vicinity of, and downgradient from, the active BX Service Station pump islands and USTs.

3.2 CLEANUP CRITERIA

This section describes Florida's closure approach for sites contaminated with petroleum products. The final draft *Petroleum Contamination Site Cleanup Criteria* rule (Chapter 62-770, FAC) (FDEP, 1997) presents guidance for determination of remedial requirements for closure of petroleum-contaminated sites, including several mechanisms for determining matrix-specific cleanup criteria. The regulations allow closure of petroleum release sites under several different scenarios, including:

- NFA Proposal Without Conditions,
- NFA Proposal With Conditions, or
- Monitoring-Only Proposal for Natural Attenuation.

Closure of a site under the NFA-Without-Conditions alternative would allow unrestricted future use of the site (e.g., residential land use), and therefore the requirements and allowable contaminant levels under this alternative are the most restrictive. The NFA-With-Conditions alternative requires that appropriate institutional or engineering controls be implemented to limit receptor exposure to contaminated media; sites seeking closure under this alternative are subject to potentially less stringent cleanup levels. A natural attenuation monitoring program is a recognized means of remediating sites with petroleum hydrocarbon contamination in groundwater, with the goal of achieving the NFA target cleanup levels.

3.2.1 No Further Action Without Conditions

Closure of a petroleum release site under an NFA Proposal without conditions requires that a site meet the following criteria:

- No mobile LNAPL (free-phase product) is present;
- No fire or explosion hazard is present due to release of petroleum or petroleum products ;
- No "excessively contaminated soil" is present; and
- Matrix-specific target cleanup levels (for soil and groundwater) are met.

Contaminant concentrations in all affected media at a site must be below all applicable target cleanup levels for the site to qualify for a NFA without conditions proposal. The *Petroleum Contamination Site Cleanup Criteria* rule (FDEP, 1997) incorporates matrix-specific target cleanup levels for petroleum constituents in the form of "look-up" tables or through reference to other applicable regulations (i.e., state groundwater or surface water regulations).

To demonstrate that contaminated soil is not present in the unsaturated zone, representative soil samples must show that concentrations of the applicable petroleum products' chemicals of concern are less FDEP (1997) direct human exposure and leachability target levels. If leachability target cleanup levels are exceeded, direct leachability testing can be performed to determine if leachate concentrations exceed the applicable groundwater target cleanup levels. In addition, the rule also allows for the development of alternative cleanup standards that can be used in place of those presented in the look-up tables. The alternative cleanup standards must be developed based on site-specific exposure scenarios and risk assessment.

3.2.2 No Further Action With Conditions

Closure of a petroleum release site under an NFA Proposal with conditions requires that a site meet the first three criteria for NFA without conditions (Section 3.2.1); however, alternative target cleanup levels may be justified by the property owner by agreeing to the enactment of institutional controls (i.e., land use restrictions) and/or engineering controls. For soil, less restrictive direct-exposure target cleanup levels may be used, and leachability target cleanup levels may be exceeded if it can be demonstrated based on site characteristics and restrictions specified in the institutional control, that petroleum product chemicals of concern will not leach into groundwater at concentrations exceeding applicable groundwater target cleanup levels. For groundwater, alternative groundwater target cleanup levels may be justified depending on the current and projected use of groundwater in the vicinity and by enacting appropriate institutional controls.

3.2.3 Natural Attenuation With Monitoring

The FDEP recognizes natural attenuation with monitoring as a viable site rehabilitation strategy for petroleum-contaminated groundwater. The following criteria must be met to demonstrate that this strategy is appropriate for a site:

- No mobile LNAPL is present;

- Contaminated soil is not present or does not constitute a continuing source of contamination to groundwater;

- Groundwater contaminant concentrations above applicable target cleanup levels are not migrating beyond a temporary POC;

- Available data show an overall decrease in the mass of contamination; and

- Contaminant concentrations in groundwater do not exceed appropriate criteria (Table IX levels, Chapter 62-770, FAC); or technical evaluations (as specified in Chapter 62-770.690 (1)(f), FAC) indicate that natural attenuation is an appropriate remedial alternative.

Natural attenuation with monitoring requires the establishment of a temporary POC based on site-specific conditions relating to land and groundwater use, potentially exposed populations, hydrogeology, and type and concentrations of contaminants. If human health, public safety, and the environment are protected, the POC may be moved to the property boundary, or beyond the property boundary (with notice), if necessary to address current plume conditions.

3.3 CLEANUP STANDARDS FOR THE BX SERVICE STATION, SITE ST-29

Based on previous soil sampling results and soil gas and respiration results obtained following approximately 3 years of SVE and pilot- and expanded-scale bioventing system operation, the majority of the soils at the site are likely to have been sufficiently remediated to meet FDEP (1997) criteria outlined in Chapter 62-770. Continued operation of the expanded-scale bioventing system since November 1996 has further reduced petroleum hydrocarbon contamination in site soils including soils near MPF. It is anticipated that the concentration of residual MOGAS chemicals of potential concern (COPCs) in unsaturated and smear zone soils in the vicinity of the active dispensing islands and USTs at the BX Service Station are less than the applicable FDEP target cleanup levels for NFA and no further soil remediation will be necessary.

3.3.1 Soil Criteria

Confirmation soil sample results will be compared to target cleanup levels established by FDEP (1997) to demonstrate that petroleum hydrocarbon contaminants in site soils have been sufficiently remediated to meet the requirements for a NFA proposal. Specifically, direct-exposure and leachability target cleanup levels from Table IV (FDEP, 1997) will be used as the initial cleanup criteria. Confirmation soil sampling results will be compared to the residential and industrial direct-exposure levels and leachability target levels for groundwater resource protection and recovery (because shallow groundwater at the site is not likely to impact surface water in the vicinity of Patrick AFB).

Table 3.1 compares the maximum detected site soil concentrations of petroleum hydrocarbon contaminants to the proposed FDEP target cleanup levels. As is evident from this comparison, pre-bioventing concentrations of benzene, ethylbenzene, xylenes and TRPH in soil were not in compliance with FDEP (1997) direct-exposure or

TABLE 3.1
COMPARISON OF MAXIMUM SITE SOIL CONCENTRATIONS TO TARGET CLEANUP LEVELS
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

Chemical Name	Units	Maximum Concentration Detected	Location of Maximum Detection	Sample Collection Date	FDEP Target Cleanup Levels [a] Direct Exposure [b] I	II	Soil Leachability [c]
TRPH [d]	mg/kg [e]	2,730	HVW-2	Mar-93	350	2,500	340
Benzene	mg/kg	6.99	CPT-02-A19	Mar-94	1.1	1.50	0.007
Ethylbenzene	mg/kg	260	HVW-2	Mar-93	240	240	0.4
Toluene	mg/kg	54	HVW-2	Mar-93	300	2,000	0.4
Xylenes	mg/kg	2,600	HVW-2	Mar-93	290	290	0.3
Acenaphthene	mg/kg	ND [f]	NA [g]	Oct-93	2,300	22,000	4
Acenaphthylene	mg/kg	ND	NA	Oct-93	1,100	11,000	22
Anthracene	mg/kg	ND	NA	Oct-93	19,000	290,000	2,000
Benzo(a)anthracene	mg/kg	ND	NA	Oct-93	1.4	5.1	2.9
Benzo(a)pyrene	mg/kg	ND	NA	Oct-93	0.1	0.5	7.8
Benzo(b)fluoranthene	mg/kg	ND	NA	Oct-93	1.4	5	9.8
Benzo (g,h,i)perylene	mg/kg	ND	NA	Oct-93	2,300	45,000	13,000
Benzo(k)fluoranthene	mg/kg	ND	NA	Oct-93	15	52	25
Chrysene	mg/kg	ND	NA	Oct-93	140	490	80
Dibenzo(a,h)anthracene	mg/kg	ND	NA	Oct-93	0.1	0.5	14
Fluoranthene	mg/kg	0.20J [h]	SB-10	Oct-93	2,800	45,000	550
Fluorene	mg/kg	ND	NA	Oct-93	2,100	24,000	87
Indeno(1,2,3-cd)pyrene	mg/kg	ND	NA	Oct-93	1.5	5.2	28
Naphthalene	mg/kg	60	SB-15	Oct-93	1,000	8,600	1
Phenanthrene	mg/kg	0.12J	SB-10	Oct-93	1,900	29,000	120
Pyrene	mg/kg	0.14J	SB-10	Oct-93	2,200	40,000	570
MTBE [i]	mg/kg	NR [j]	NA	NA	350	6,100	0.2
Lead	mg/kg	15.3	SB-6	1990	500	1,000	100/TCLP [k]

Notes: Shading indicates maximum site concentration above target cleanup level indicated.

[a] FDEP, 1997.

[b] Direct Exposure I and II are for No Further Action Without or With Conditions.

[c] Based on Table V (Groundwater Cleanup Target Levels).

[d] TRPH = total recoverable petroleum hydrocarbons. Maximum concentration based on analysis by USEPA Method 418.1; total petroleum hydrocarbons (TPH) concentrations from March 1994 not considered. Target cleanup levels based on State of Florida FL-PRO analysis.

[e] mg/kg = milligrams per kilogram.

[f] ND = not detected; laboratory reporting limit not available.

[g] NA = not applicable.

[h] J = analyte detected below laboratory reporting limit; the value shown represents a laboratory estimated concentration.

[i] MTBE = methyl tert-butyl ether.

[j] NR = no results available.

[k] If total lead concentration exceeds 100 mg/kg when analyzed by USEPA SW7421, then sample must pass Toxicity Characteristic Leaching Procedure (TCLP) criterion of 5.0 mg/L for total lead.

leachability target cleanup levels. However, it is anticipated that representative confirmation soil sample results will demonstrate that the concentration of these contaminants in soil following approximately 4.5 years of soil venting treatment now are below the prescribed levels.

3.3.2 Alternative Cleanup Standards

For those contaminants exceeding target cleanup levels for NFA (With or Without Conditions), alternative cleanup standards for soil contaminated with petroleum products may be developed based on a site-specific risk assessment. Development of alternative standards for those chemicals that are below the more stringent levels provided in the Rule should not be necessary.

If performed, the risk assessment would include a site-specific exposure assessment based on:

- Chemical concentrations in all contaminated media;
- Soil properties;
- Potential exposure pathways and routes;
- Current or potential future exposed populations;
- Exposure factors (i.e., exposure duration and frequency); and
- Expected contaminant concentrations to which actual or potential receptors may be exposed.

In establishing alternative target cleanup levels, the following factors would be used, as appropriate:

- Calculations using a lifetime cancer risk level of 1.0×10^{-6} for carcinogenic COPCs;
- A hazard index of 1 or less for noncarcinogenic COPCs;
- Best achievable detection limits;
- Naturally occurring background concentrations (for inorganics); and/or
- Nuisance, organoleptic, or aesthetic considerations.

These alternative site-specific target cleanup levels, if developed, would be used for closure under an NFA With Conditions proposal.

SECTION 4

SITE CONFIRMATION SOIL AND GROUNDWATER SAMPLING AND ANALYSIS PLAN

The following SAP describes the borehole locations, sampling depths, soil sampling procedures, and analytical methods proposed to collect sufficient data to verify remediation of petroleum hydrocarbon contaminants in vadose and smear zone soils at the BX Service Station to proposed cleanup levels (Table 3.1).

4.1 SOIL SAMPLING

This section describes the scope of work required for collecting confirmation soil samples at the BX Service Station. An estimated 15 boreholes will be drilled and sampled in the vicinity of the active fueling facilities in the area previously shown to contain elevated hydrocarbon concentrations in saturated and unsaturated zone soils (Figure 2.6). A maximum of two additional boreholes may be drilled and sampled if field screening results indicate significant contamination extending beyond the proposed sampling area. Proposed borehole locations are shown on Figure 4.1.

One month prior to soil sampling, the expanded-scale bioventing system at the BX Service Station will be shut down to allow subsurface conditions to return to equilibrium. Soil sampling will be conducted by qualified Parsons ES scientists and technicians trained in the conduct of soil sampling, records documentation, and environmental sample chain-of-custody procedures. In order to provide complete documentation of the sampling event, detailed records will be maintained by the Parsons ES field hydrogeologist. In addition, sampling personnel will have thoroughly reviewed this SAP prior to sample collection and will have a copy available onsite for reference.

4.1.1 Drilling, Sampling, and Equipment Decontamination

Soil boreholes will be advanced to the groundwater table surface (approximately 4 to 6 feet bgs) with a hand auger. Undisturbed soil samples, suitable for chemical analysis, will be obtained from each borehole by collecting the required volume of soil directly from the hand-auger bucket. Soil types will be classified according to the Unified Soil Classification System (USCS) and described in accordance with the standard Parsons ES soil description format. All soil samples will be visually examined, and sample headspace will be field screened for VOCs using a photoionization detector (PID) or a TVH analyzer (TVHA). The data obtained from the logging and screening will be recorded on borehole logs.

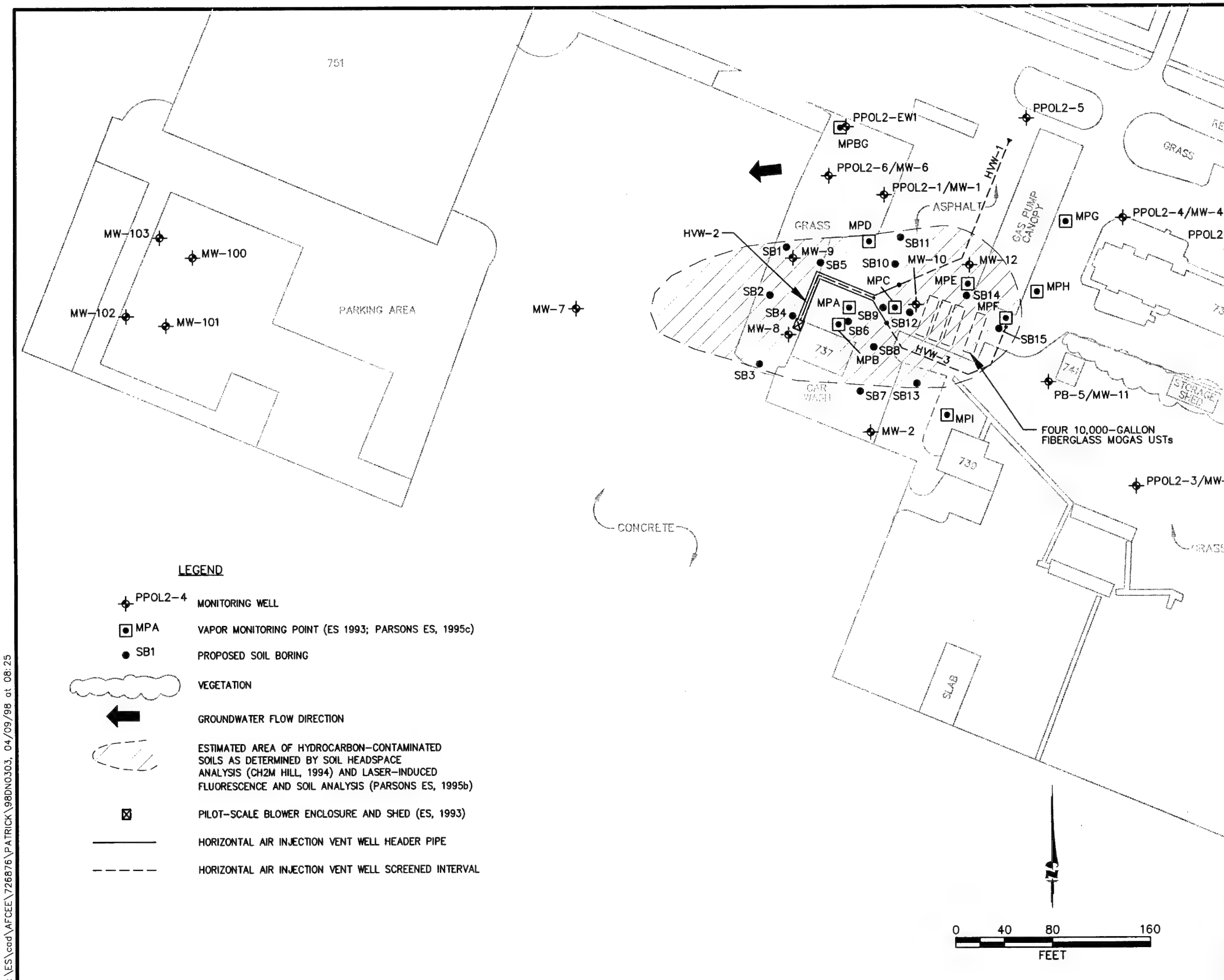

FIGURE 4.1

PROPOSED CONFIRMATION SOIL SAMPLING LOCATIONS

BX Service Station
Site ST-29
Patrick AFB, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

Based on field screening results, one sample with the greatest apparent petroleum hydrocarbon contamination from each boring will be selected and submitted for laboratory analysis using laboratory-prepared containers. Samples selected for laboratory analysis will be labeled with the site name and borehole number, sample depth, date of collection, project name, and other pertinent data. The sample containers will be sealed in plastic bags and immediately placed in an insulated cooler containing ice. The soil samples will be maintained in a chilled condition until delivered to the analytical laboratory. Chain-of-custody records will be prepared in the field and will accompany the samples to the analytical laboratory.

Augers and other downhole equipment will be cleaned before use and between boreholes to prevent cross-contamination. Between sampling events, the hand-auger bucket will be cleaned with Alconox® detergent, followed by successive potable and distilled water rinses. Decontamination water and auger cuttings will be managed as described in Section 4.4. Boreholes will be abandoned using bentonite following drilling and sampling. Boreholes drilled through asphalt will be repaired at the surface using asphalt cold-patch.

4.1.2 Soil Sample Analyses

Proposed soil sample analytical methods, estimated number of samples, and reporting limits are presented in Table 4.1. All samples will be analyzed by a State of Florida-certified and AFCEE-approved laboratory. Parsons ES proposes to analyze samples from the BX Service Station for TRPH by State of Florida Method FL-PRO; for BTEX using USEPA Method SW8020; and for PAHs using USEPA Method SW8310. Quality control (QC) samples also will be analyzed to assess laboratory methods. The laboratory will perform analyses on one matrix spike, one laboratory control sample, and one laboratory blank for each specific analytical method requested. Field QC samples will be collected and analyzed as described in Section 4.3.

4.2 CHAIN-OF-CUSTODY CONTROL

After the samples for laboratory analysis have been collected, chain-of-custody procedures will be followed to establish a written record of sample handling and movement between the sampling site and the laboratory. Samples collected for onsite field analyses will not require chain-of-custody records. Each shipping container will have a chain-of-custody form completed in triplicate by the sampling personnel. One copy of this form will be kept by the sampling contractor after sample delivery to the analytical laboratory, and the other two copies will be submitted to the laboratory with the samples. One of the laboratory copies will become a part of the permanent record for the sample and will be returned to Parsons ES with the sample analytical results. The chain-of-custody will contain the following information:

- Site name and address;
- Sample identification number;
- Sample collector's printed name and signature;

TABLE 4.1
PROPOSED SOIL SAMPLE ANALYTICAL METHODS, REPORTING LIMITS, AND NUMBER OF SAMPLES
BX SERVICE STATION
SITE ST-29
PATRICK AFB, FLORIDA

Analytical Method	Number of Samples[a/]	Reporting Limit[b/]	Units[c/]	Field or Fixed-Base Laboratory
State of Florida FL-PRO				
TRPH[d/]	15	TBD[e/]	mg/kg	Fixed-base
USEPA Method SW8020				
Benzene	15	1.0	µg/kg	Fixed-base
Toluene	15	2.0	µg/kg	Fixed-base
Ethylbenzene	15	2.0	µg/kg	Fixed-base
Xylenes	15	2.0	µg/kg	Fixed-base
MTBE[f/]	15	1.0	µg/kg	Fixed-base
USEPA Method SW8310				
Acenapthene	15	1,200	µg/kg	Fixed-base
Acenaphthylene	15	1,540	µg/kg	Fixed-base
Anthracene	15	440	µg/kg	Fixed-base
Benzo(a)anthracene	15	9	µg/kg	Fixed-base
Benzo(a)pyrene	15	15	µg/kg	Fixed-base
Benzo(a)fluoranthene	15	12	µg/kg	Fixed-base
Benzo(g,h,i)perylene	15	50	µg/kg	Fixed-base
Benzo(k)fluoranthene	15	11	µg/kg	Fixed-base
Chrysene	15	100	µg/kg	Fixed-base
Dibenzo(a,h)anthracene	15	20	µg/kg	Fixed-base
Fluoranthene	15	140	µg/kg	Fixed-base
Fluorene	15	140	µg/kg	Fixed-base
Indeno(1,2,3-cd)pyrene	15	30	µg/kg	Fixed-base
Naphthalene	15	1,200	µg/kg	Fixed-base
Phenanthrene	15	420	µg/kg	Fixed-base
Pyrene	15	180	µg/kg	Fixed-base

[a/] Excludes QC samples. If optional boreholes are required, one additional soil sample per optional borehole also will be collected and analyzed.

[b/] Project reporting limit as specified in subcontract for analytical services.

[c/] mg/kg = milligrams per kilogram; µg/kg = micrograms per kilogram.

[d/] TRPH = total recoverable petroleum hydrocarbons.

[e/] TBD = to be determined.

[f/] MTBE = methyl tert-butyl ether.

22/726876/PATRICK/2.xls\Table 4.1

- Date and time of collection;
- Place and address of collection;
- Type of sample (i.e. composite, grab, etc.);
- Sample matrix (soil or groundwater);
- Chemical preservatives added;
- Analytical laboratory to be utilized;
- Analyses requested;
- Signatures of individuals involved in the chain of possession; and
- Inclusive dates of possession.

The chain-of-custody documentation will be placed inside the shipping container so that it will be immediately apparent to the laboratory personnel receiving the container, but will not be damaged or lost during transport. The shipping container will be sealed so that it will be obvious if the seal has been tampered with or broken.

4.3 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Samples must be collected, preserved, transported, and analyzed in such a manner that sampling results yield information that provides a reliable representation of the soil and groundwater quality at the site. To meet this requirement, the procedures described in Sections 4.1 will be followed during sample collection, handling, and analysis. In addition, laboratory QC samples will be analyzed as described in Sections 4.1.2.

Field quality assurance will include collection of field replicates, rinseate blanks, and trip blanks. Soil QC sampling will include two replicates (minimum frequency of 10 percent), one rinseate blank, and one trip blank for each cooler with samples designated for BTEX analysis.

4.4 MANAGEMENT OF INVESTIGATION-DERIVED WASTES

Soil cuttings generated during hand-auger soil sampling will be minimal. Residual cuttings not prepared for laboratory analysis will be returned to their respective soil borehole prior to plugging the borehole with bentonite. Equipment decontamination and rinseate water will be accumulated, transferred to a truck-mounted tank, and transported to the Trident STP (an industrial wastewater treatment plant) at Cape Canaveral Air Station (AS) for discharge and treatment. The site name, source location, volume, date of collection, and other pertinent information will be recorded in the Cape Canaveral AS investigation-derived waste inventory maintained by Parsons ES.

SECTION 5

SITE CONFIRMATION SAMPLING REPORT FORMAT

Following receipt and evaluation of the laboratory analytical results, a draft confirmation soil sampling report will be prepared. The report will summarize soil analytical results from the confirmation sampling event in order to demonstrate source removal and support recommendations for NFA (i.e., no further soil remediation), if appropriate. The confirmation sampling report and recommendations will be submitted to FDEP, Patrick AFB, and AFCEE.

As a minimum, the report will contain the following information for the BX Service Station:

- This confirmation SAP (as an appendix);
- Site plot plan showing sampling locations;
- Summary of field activities;
- Assessment of soil analytical results in comparison to applicable FDEP (1997) target cleanup levels (Tables 3.1);
- Laboratory analytical reports and chain-of-custody forms;
- Borehole logs;
- FDEP (1997) required information, conclusions, and recommendations for NFA (Chapter 62-770.680, FAC), natural attenuation and monitoring-only (Chapter 62-770.690, FAC), or additional active remediation (Chapter 62-770.700, FAC) or monitoring (Chapter 62-770. 750., FAC), as appropriate, based on available analytical results.

SECTION 6

PATRICK AFB SUPPORT REQUIREMENTS

The following Patrick AFB support is needed prior to the arrival of the Parsons ES team:

- Assistance in obtaining digging permits,
- Arrangement of site access for Parsons ES, and
- Assistance in handling/disposal of decontamination/rinseate waters in accordance with Section 4.4.

SECTION 7

PROJECT SCHEDULE

The following schedule is contingent upon timely approval of this confirmation SAP and fulfillment of the Patrick AFB support requirements outlined in Section 6.

Event	Date
Submit Draft Confirmation SAP to AFCEE and Patrick AFB	29 April 1998
Receipt of AFCEE and Patrick AFB Comments	29 May 1998
Submit Final SAP to AFCEE, Patrick AFB, and FDEP*	June 1998
Confirmation Sampling	July 1998
Submit Draft Confirmation Sampling Report to AFCEE and Patrick AFB	October 1998
Receipt of AFCEE and Patrick AFB Comments	November 1998
Submit Draft Final Confirmation Sampling Report to AFCEE, Patrick AFB, and FDEP	December 1998

* FDEP review and comment on the SAP occurred during the 17 April 1998 Petroleum Action Management Plan (PAMP) Meeting.

SECTION 8

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SECTION 9

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APPENDIX A

BX SERVICE STATION (SITE ST-29) GROUNDWATER DATA

APPENDIX A-1

GROUNDWATER DATA FROM OB&G, 1994 AND 1995

TABLE 1-1 - ST-29 (PPOL-2) PREVIOUSLY DETECTED COMPOUNDS PHASE II, STAGE 2, ROUND 1 AND 2 GROUND WATER

Parameters	Units	WELL PPOL2-1		WELL PPOL2-2		WELL PPOL2-3		WELL PPOL2-4		WELL PPOL2-5		WELL PPOL2-6	
		Stage 2 Round 1	Stage 2 Round 2	Stage 2 Round 1	Stage 2 Round 2	Stage 2 Round 1	Stage 2 Round 2	Stage 2 Round 1	Stage 2 Round 2	Stage 2 Round 1	Stage 2 Round 2	Stage 2 Round 1	Stage 2 Round 2
Petroleum Hydrocarbons	mg/L	0.8	–	–	–	–	–	–	–	–	–	–	–
Lead, total	mg/L	0.0025	0.0101	–	0.0039	0.0070	0.0221	0.0017	0.0027	0.0033	0.0095	–	–
Lead, dissolved	mg/L	–	–	–	–	–	0.0029	–	0.0014	–	–	–	–
Bromodichloromethane	µg/L	–	–	–	–	–	–	–	3.10	–	–	–	–
Chloroform	µg/L	–	–	–	–	–	–	–	6.63	–	–	–	–
Chloromethane	µg/L	–	–	0.699	–	ND	–	–	–	–	–	–	–
Trans-1,2-dichloroethene	µg/L	–	0.31	–	–	–	–	–	–	–	0.65	–	–
Methylene Chloride	µg/L	–	–	–	–	–	–	–	ND	–	–	–	–
Trichloroethene	µg/L	–	0.702	–	–	–	–	–	–	–	–	–	–
Chlorobenzene	µg/L	0.387	–	–	–	–	–	–	–	–	–	–	–
Toluene	µg/L	0.85	–	–	–	–	–	0.72	–	–	–	–	–
Xylenes, total	µg/L	1.56	–	–	–	–	–	1.62	–	–	–	–	–
Methyl-T-butylether	µg/L	151	ND	0.910	–	–	–	13.3	–	–	ND	–	–
Bis(2-ethylhexyl) phthalate	µg/L	NRQ	–	NRQ	–	NRQ	–	NRQ	–	NRQ	–	NRQ	4.2

KEY:
– = current concentration less than instrument detection limit
ND = Not Detected
NRQ = Not Requested

Source: ESE, 1991.

[redacted]BLE [redacted] ST[redacted](PP[redacted]) G[redacted]TER[redacted]MPL[redacted] AN[redacted]SIS[redacted]SUL[redacted]

		PPOL2-4		PPOL2-5		PPOL2-7		PPOL2-8	DUP		PPOL2-9		DUP	PPOL2-10	DUP
PARAMETER	Units	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 1	Round 2	Round 1	Round 2	Round 2	Round 1	
VOLATILE ORGANICS (USEPA METHOD SW-846 8010/8020)															
Benzene	ug/L	ND	ND	ND	ND	ND	ND	6	3	46	ND	ND	ND	ND	ND
Benzyl chloride	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA
Bromobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromodichloromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromoform	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bromomethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Carbon tetrachloride	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloroform	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Chlorohexane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloroethyl vinyl ether	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chloromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorotoluene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Dibromochloromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
1,1-Dichloroethane	ug/L	ND	ND	ND	ND	1	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
cis-1,3-Dichloropropene	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
trans-1,2-Dichloroethylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trichlorofluoromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dichloromethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[redacted]ABLE[redacted]6 - S[redacted] (P[redacted]2) [redacted]UN[redacted]ATE[redacted]AMP[redacted]G A[redacted]YSI[redacted]SU[redacted]

		PPOL2-4		PPOL2-5		PPOL2-7		PPOL2-8	DUP		PPOL2-9		DUP	PPOL2-10	DUP
PARAMETER	Units	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 1	Round 2	Round 1	Round 2	Round 2	Round 1	
Tetrachloroethylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Trichloroethylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vinyl Chloride	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	ug/L	ND	ND	ND	ND	ND	ND	8	4	43	ND	ND	ND	ND	ND
Toluene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Xylenes, (Total)	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Methyl tert-butyl ether	ug/L	ND	ND	15	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total VOA	ug/L	0.0	0.0	15	0.0	1	0.0	14	7	89	0.0	0.0	0.0	0.0	0.0
Semi-Volatile Organics (USEPA Method SW846 8270)															
Acenaphthene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzidine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)anthracene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA
Benzo(b)fluoranthene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzoic Acid	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Benzo(k)fluoranthene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(ghi)perylene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo(a)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzyl alcohol	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Bis(2-chloroethoxy)methane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	21	ND	18	ND	ND	ND	ND
4-Bromophenyl phenyl ether	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Butyl benzyl phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[redacted]ABLE 2-[redacted] ST[redacted](PPO[redacted]) GR[redacted]ND [redacted]TER [redacted]MPL[redacted]ANA[redacted]SIS [redacted]ULT[redacted]

		PPOL2-4		PPOL2-5		PPOL2-7		PPOL2-8	DUP		PPOL2-9		DUP	PPOL2-10	DUP
PARAMETER	Units	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 1	Round 2	Round 1	Round 2	Round 2	Round 1	
4-Chloroaniline	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
4-Chloro-3-methylphenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Chlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ug/L	ND	NA	ND	NA	ND	NA	ND	ND	NA	ND	NA	NA	ND	ND
1,2-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzofuran	ug/L	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
3,3'-Dichlorobenzidine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Diethyl phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dimethyl phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-mehtylphenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno(1,2,3-cd)pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	ug/l	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
2-Methylphenol	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
4-Methylphenol	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND

TABLE 2-6 - ST-29 (PPOL-2) GROUNDWATER SAMPLING ANALYSIS RESULTS

		PPOL2-4		PPOL2-5		PPOL2-7		PPOL2-8	DUP		PPOL2-9		DUP	PPOL2-10	DUP
PARAMETER	Units	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 1	Round 2	Round 1	Round 2	Round 2	Round 1	
Naphthalene	ug/l	ND	ND	ND	ND	ND	110	ND	8J	ND	ND	ND	ND	ND	ND
2-Nitroaniline	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Nitrobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
3-Nitroaniline	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
4-Nitroaniline	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
2-Nitrophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4-Nitrophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodimethylamine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodi-n-propylamine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pentachlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
2,4,6-Trichlorophenol	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
1-Methylnaphthalene	ug/l	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	ND	ND
Total PAHs (-Naphthalenes)	ug/L	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Naphthlenes	ug/L	0.0	0.0	0.0	0.0	0.0	110	0.0	8J	0.0	0.0	0.0	0.0	0.0	0.0

TABLE 2-6 - ST-29 (PPOL-2) GROUNDWATER SAMPLING ANALYSIS RESULTS

		PPOL2-4		PPOL2-5		PPOL2-7		PPOL2-8	DUP		PPOL2-9		DUP	PPOL2-10	DUP
PARAMETER	Units	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 1	Round 2	Round 1	Round 2	Round 2	Round 1	
LEAD (MCAWW 239.2)															
Total	ug/L	10	5	ND	4J	47	1J	6	ND	2J	36.4	17	23	320	62
Dissolved	ug/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	1J
TOTAL RECOVERABLE PETROLEUM HYDROCARBONS (USEPA METHOD E418.1)															
TRPH	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Notes:

NA = Not Analyzed

ND = Not detected

DUP = QC/QA Duplicate Sample

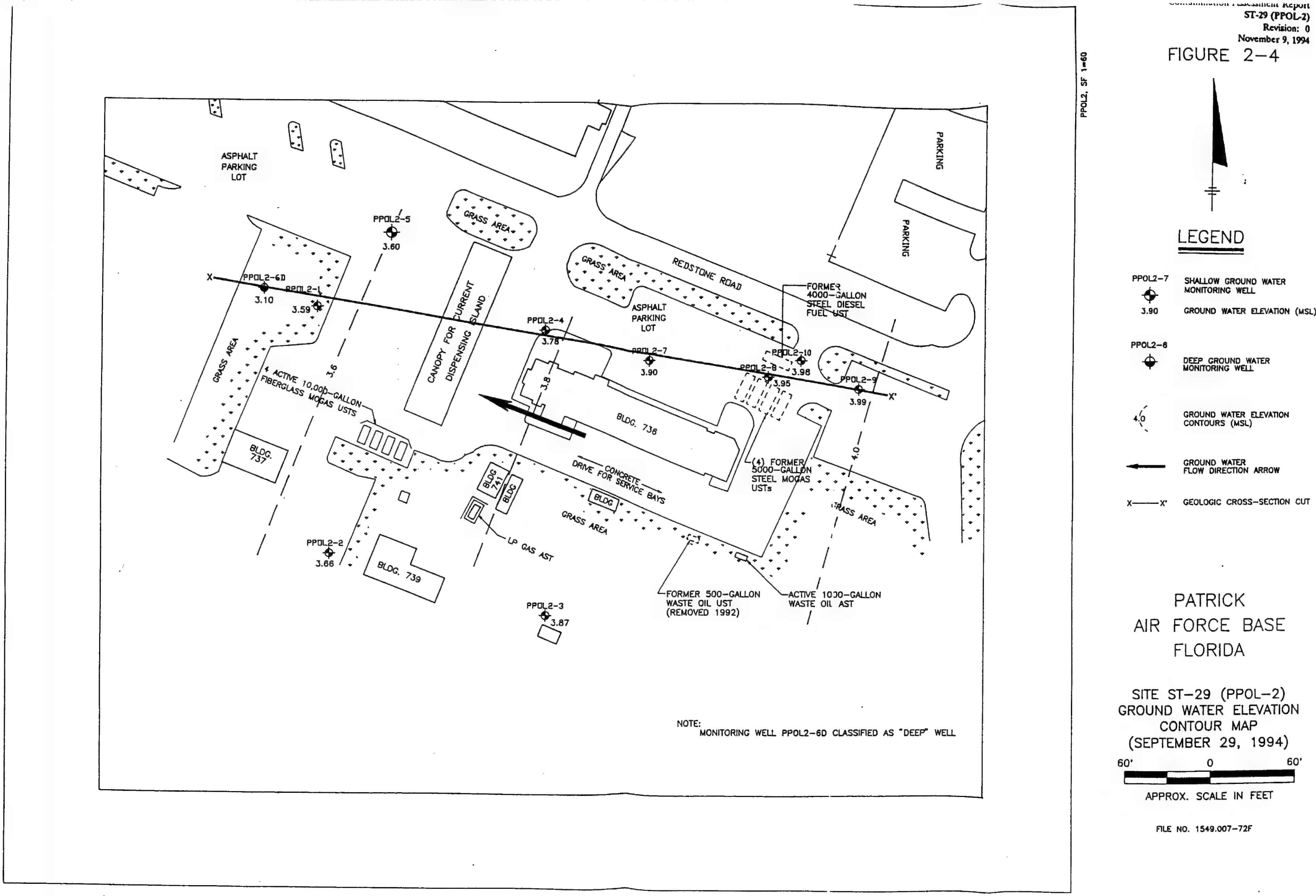
J = Estimated Value. Detected, but below quantitation limit.

Round 1 Ground Water Samples Collected June 17 through July 16, 1993 (PPOL2-5 resamples for SVOCs July 16, 1993 due to laboratory error.)

Round 2 Ground water samples collected August 18 and 19, 1993 (PPOL2-4 resampled for VOCs, SVOCs, TRPH, Total Dissolved Pb October 8, 1993 due to laboratory error.)

Monitoring Well PPOL2-10 sampled for VOCs and SVOCs, January 1994; sampled for TRPH, Total Dissolved Pb. February 1994.

FIGURE 2–4

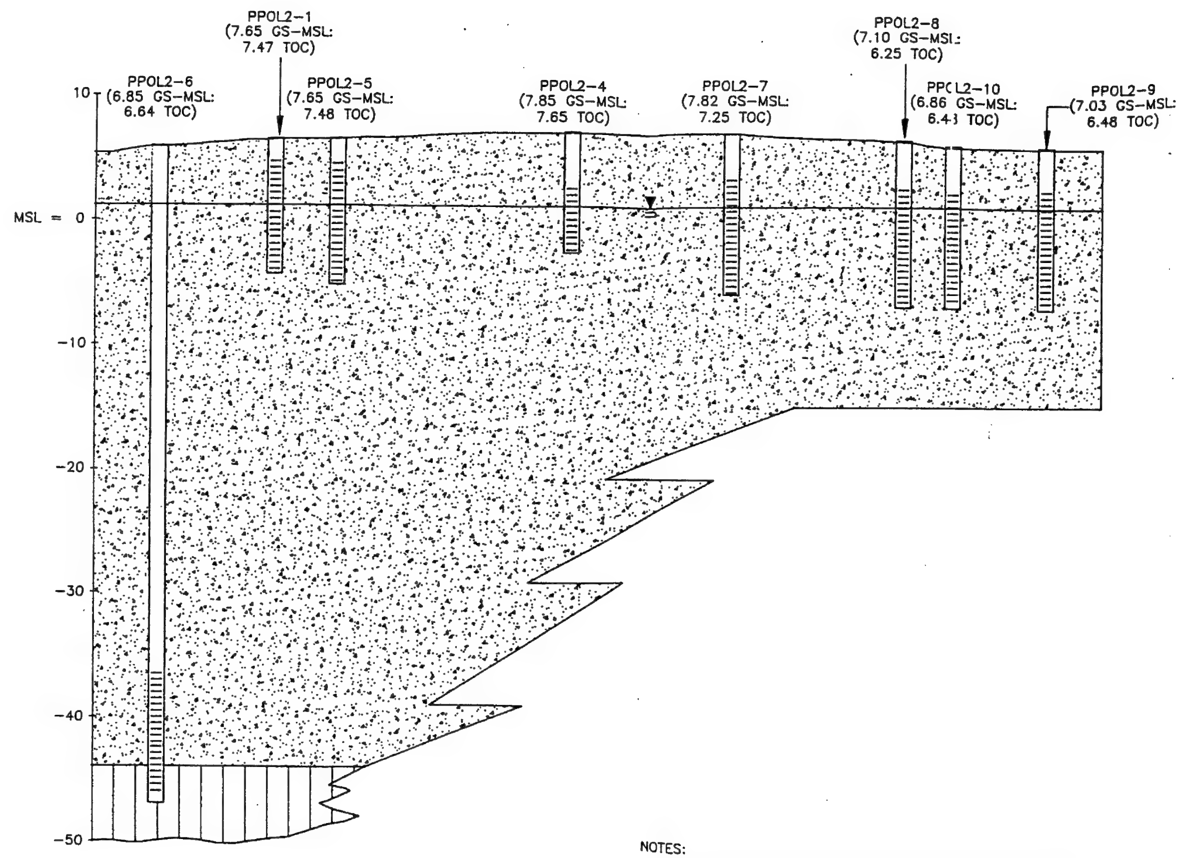


PATRICK
AIR FORCE BASE
FLORIDA

SITE ST–29 (PPOL–2)
GROUND WATER ELEVATION
CONTOUR MAP
(SEPTEMBER 29, 1994)

FILE NO. 1549.007–72F

FIGURE 2–5



29FIG2–5, SF 1=40

HORIZONTAL SCALE – 1"=40'
VERTICAL SCALE – 1"=10'

NOTES:

WELL CASING AND SCREENS WIDTHS ARE NOT TO SCALE

GS–MSL = GROUND SURFACE–MEAN SEA LEVEL

TOC = TOP OF CASING

ELEVATIONS BASED ON NORTH AMERICAN DATUM 1993 GEODETIC AND STATE PLANE COORDINATE SYSTEM, BENCHMARK LOCATED AT: "BOOK 1975", SE CORNER PARKING LOT ADJACENT EAST TO BASE LIBRARY; ELEVATION BEING: 8.278 FEET OR 2.523 METERS, MEAN SEA LEVEL.

LEGEND

- CASED INTERVAL
- SCREENED INTERVAL
- GROUND WATER SURFACE (JUNE 17, 1993)
- SAND/SHELL
- SANDY CLAY OR CLAY

CAPE CANAVERAL
AIR FORCE STATION
FLORIDA

SITE ST–29 (PPOL–2)
GEOLOGIC CROSS SECTION

40' 0 40'

APPROX. SCALE IN FEET

FILE NO. 1549.007–73F

APPENDIX A-2

GROUNDWATER DATA FROM PARSONS ES, 1995B

TABLE 4.3

FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUNDWATER, MARCH 1994
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA

Sample Location	Sample Number	Sample Date	Benzene (μg/L)	Toluene (μg/L)	Ethylbenzene (μg/L)	p-Xylene (μg/L)	m-Xylene (μg/L)	o-Xylene (μg/L)	Total Xylenes (μg/L)	Total BTEX (μg/L)	1,3,5-TMB (μg/L)	1,2,4-TMB (μg/L)	1,2,3-TMB (μg/L)
CPT-01	CPT-86-001	3-23-94	BLQ[a]	2.42	BLQ	BLQ	BLQ	BLQ	BLQ	2.42	BLQ	BLQ	BLQ
CPT-02S	CPT-86-002S	3-23-94	375	18.9	165	166	353	119	638	1196.9	71.2	NA[b]	86.3
CPT-02D	CPT-86-002D	3-23-94	1.5	1.7	1.1	1.4	2.6	1.4	5.4	9.7	BLQ	NA	1.3
CPT-03S	CPT-86-003S	3-23-94	724	737	823	1220	2410	1390	5020	7304	347	NA	403
CPT-03M	CPT-86-003M	3-23-94	207	15.6	40.5	42.2	24	7.5	73.7	336.8	2.8	NA	16
CPT-03D	CPT-86-003D	3-23-94	1.8	1.1	BLQ	BLQ	1.4	BLQ	1.4	4.3	BLQ	NA	BLQ
CPT-04S	CPT-86-004S	3-23-94	BLQ	6	BLQ	BLQ	BLQ	BLQ	BLQ	6	BLQ	BLQ	BLQ
CPT-04D	CPT-86-004D	3-25-94	BLQ	3.7	BLQ	BLQ	BLQ	BLQ	BLQ	3.7	BLQ	BLQ	BLQ
CPT-05S	CPT-86-005S	3-25-94	BLQ	1.2	BLQ	BLQ	BLQ	BLQ	BLQ	1.2	BLQ	NA	BLQ
CPT-06S	CPT-86-006S	3-25-94	BLQ	11.1	BLQ	1.3	2.3	BLQ	3.6	14.7	BLQ	NA	BLQ
CPT-07S	CPT-86-007S	3-25-94	BLQ	3.9	BLQ	BLQ	1	BLQ	1	4.9	BLQ	NA	BLQ
CPT-08S	CPT-86-008S	3-25-94	BLQ	2.8	BLQ	BLQ	BLQ	BLQ	BLQ	2.8	BLQ	BLQ	BLQ
CPT-09S	CPT-86-009S	3-25-94	2	4	BLQ	BLQ	BLQ	BLQ	BLQ	6	BLQ	BLQ	BLQ
CPT-09D	CPT-86-009D	3-25-94	427	14.1	2.9	11.7	12.1	9.7	33.5	477.5	BLQ	NA	9.4
CPT-10S	CPT-86-010S	3-25-94	BLQ	3.1	BLQ	BLQ	BLQ	BLQ	BLQ	3.1	BLQ	BLQ	BLQ
CPT-11S	CPT-86-011S	3-25-94	BLQ	1	BLQ	BLQ	BLQ	BLQ	BLQ	1	BLQ	BLQ	BLQ
CPT-12S	CPT-86-012S	3-25-94	BLQ	1.1	BLQ	BLQ	1.2	BLQ	1.2	2.3	BLQ	NA	BLQ
CPT-12D	CPT-86-012D	3-25-94	93.5	5.9	BLQ	8.4	7	3.7	19.1	118.5	BLQ	NA	4.1
CPT-13S	CPT-86-013S	3-25-94	BLQ	8.4	BLQ	10.4	5.4	3.1	18.9	56.4	BLQ	NA	6.7
CPT-16S	CPT-86-016S	3-26-94	1	1.9	BLQ	BLQ	BLQ	BLQ	BLQ	2.9	BLQ	BLQ	BLQ
CPT-16DD	CPT-86-016DD	3-31-94	BLQ	1.9	BLQ	BLQ	BLQ	BLQ	BLQ	1.9	BLQ	BLQ	BLQ
CPT-18S	CPT-86-018S	3-24-94	BLQ	1.7	2.3	3.8	6.6	4	14.4	18.4	1.4	NA	1.6
CPT-18D	CPT-86-018D	3-24-94	8.3	2.1	BLQ	BLQ	BLQ	BLQ	BLQ	10.4	BLQ	BLQ	BLQ
CPT-18DD	CPT-86-018DD	3-31-94	BLQ	3.5	BLQ	BLQ	BLQ	BLQ	BLQ	3.5	BLQ	BLQ	BLQ
CPT-19S	CPT-86-019S	3-24-94	BLQ	BLQ	1.1	1.5	2.7	BLQ	4.2	5.3	BLQ	NA	BLQ
CPT-19D	CPT-86-019D	3-24-94	1.5	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	1.5	BLQ	BLQ	BLQ
CPT-20S	CPT-86-020S	3-24-94	BLQ	2.1	BLQ	1.5	2.7	1.8	6	8.1	BLQ	NA	1
CPT-20D	CPT-86-020D	3-24-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
CPT-21S	CPT-86-021S	3-25-94	NA	5.1	BLQ	BLQ	BLQ	BLQ	BLQ	5.1	BLQ	NA	BLQ
CPT-21D	CPT-86-021D	3-25-94	NA	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
CPT-22S	CPT-86-022S	3-26-94	NA	1.9	BLQ	BLQ	BLQ	BLQ	BLQ	1.9	BLQ	BLQ	BLQ
CPT-22D	CPT-86-022D	3-26-94	1.5	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	1.5	BLQ	BLQ	BLQ
CPT-23S	CPT-86-023S	3-25-94	BLQ	BLQ	BLQ	BLQ	1.7	BLQ	1.7	1.7	BLQ	NA	BLQ
CPT-23D	CPT-86-023D	3-25-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
CPT-24S	CPT-86-024S	3-26-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ

TABLE 4.3 (CONCLUDED)

FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUNDWATER, MARCH 1994
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA

Sample Location	Sample Number	Sample Date	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	p-Xylene (µg/L)	m-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylenes (µg/L)	Total BTEX (µg/L)	1,3,5-TMB (µg/L)	1,2,4-TMB (µg/L)	1,2,3-TMB (µg/L)
CPT-24D	CPT-86-024D	3-26-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
CPT-25S	CPT-86-025S	3-26-94	BLQ	2.1	2.3	4.1	6.9	3.5	14.5	18.9	1.7	NA	1.5
CPT-25D	CPT-86-025D	3-26-94	BLQ	1	BLQ	BLQ	1.4	BLQ	1.4	2.4	BLQ	NA	BLQ
CPT-26S	CPT-86-026S	3-26-94	BLQ	1.1	BLQ	BLQ	BLQ	BLQ	BLQ	1.1	BLQ	BLQ	BLQ
CPT-26D	CPT-86-026D	3-26-94	BLQ	1	BLQ	BLQ	BLQ	BLQ	BLQ	1	BLQ	BLQ	BLQ
CPT-14D	CPT-86-014D	3-25-94	960	16.6	11.5	39.2	36.8	44.2	120.2	1108.3	15.3	NA	23
MW-100	CPT-86-100	3-23-94	4.1	BLQ	BLQ	1.1	1	BLQ	2.1	6.2	BLQ	BLQ	BLQ
PB5	CPT-86-PB5	3-26-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
MW-101	CPT-86-101	3-23-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
MW-102	CPT-86-102	3-23-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
MW-103	CPT-86-103	3-23-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
PPOL2-6	CPT-86-PPOL2-6	3-26-94	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ	BLQ
PPOL2-1	CPT-86-PPOL2-1	3-26-94	BLQ	BLQ	BLQ	BLQ	1.4	BLQ	1.4	1.4	BLQ	BLQ	BLQ

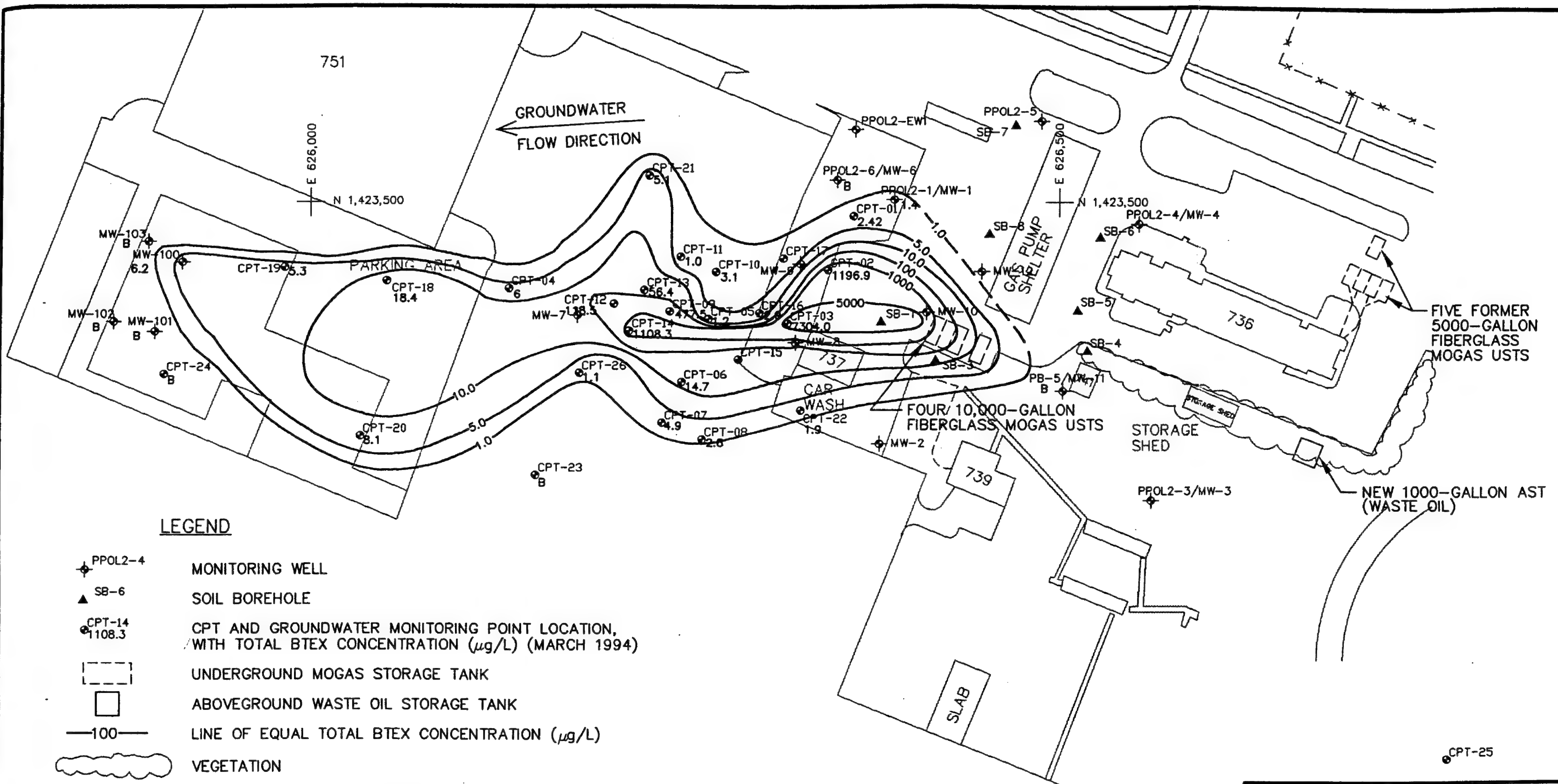
a/ BLQ = Below quantitation limit, or < 1 µg/L.
b/ NA=Not available.

TABLE ..4

FUEL HYDROCARBON COMPOUNDS DETECTED IN GROUNDWATER, MARCH AND MAY 1995
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA

Sample Location	Sample Number	Sample Date	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	p-Xylene (µg/L)	m-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylene (µg/L)	Total BTEX (µg/L)	1,3, 5 TMB (µg/L)	1,2,4 TMB (µg/L)	1,2,3 TMB (µg/L)	Total TMB (µg/L)	TOC (mg/L)
CPT-02S	2S	3/23/95	167.29	6.25	132.59	95.65	156.04	8.58	260.27	566.4	43.95	203.4	89.18	336.53	14.9
CPT-02S	2S DUP	3/23/95	156.45	6.37	135.4	107.45	168.18	9.36	284.99	583.21	48	202.48	89.97	340.45	16.3
CPT-03D	3D	3/23/95	30.95	BLQ[a]	10.49	22.49	2.96	1.39	26.84	68.28	1.4	1.97	2.87	6.24	13.8
CPT-03D	3D DUP	3/23/95	30.31	0.99	10.39	17.78	1.12	2.05	20.95	62.64	1.42	1.64	3.26	6.32	NA[b]
CPT-03M	3M	3/23/95	134.41	14.03	21.8	58.18	32.43	32.14	122.75	292.99	7.75	30.67	18.58	57	35.8
CPT-03S	3S	3/23/95	1496.39	1526.23	2252.51	2855.12	3466.78	2498.73	8820.63	14095.76	776.78	2903.48	850.57	4530.83	181.9
CPT-09D	9D	3/25/95	44.78	4.35	0.98	4.81	4.01	5.36	14.18	64.29	1.38	1.45	7.26	10.09	21.8
CPT-09S	9S	3/25/95	1.09	BLQ	1.29	1.82	1.73	1.45	5	7.38	1.09	2.46	3.6	7.15	3
CPT-12D	12D	3/25/95	BLQ	BLQ	BLQ	1.21	1.33	0.99	3.53	3.53	1.15	1.33	2.75	5.23	10.9
CPT-12S	12S	3/25/95	BLQ	ND[c]	BLQ	BLQ	1.08	BLQ	1.08	1.08	ND	ND	1.27	1.27	6.1
CPT-26D	26D	3/26/95	BLQ	ND	BLQ	BLQ	0.96	ND	0.96	0.96	1.04	ND	ND	1.04	9.5
CPT-26S	26S	3/26/95	BLQ	1.67	ND	BLQ	BLQ	ND	BLQ	1.67	1.06	1.31	ND	2.37	3.4
CPT-04D	86-4D	3/25/95	BLQ	1	BLQ	1.06	1.13	1.35	3.54	4.54	1.11	ND	1.98	3.09	7.8
CPT-04S	86-4S	3/23/95	BLQ	0.97	BLQ	1.06	1.22	1.3	3.58	4.55	1.27	ND	1.84	3.11	7.5
CPT-04S	86-4S DUP	3/23/95	BLQ	ND	BLQ	BLQ	0.99	ND	0.99	0.99	ND	1.7	1.42	3.12	7.5
CPT-16DD	86-16DD	3/31/95	BLQ	BLQ	BLQ	BLQ	1.03	BLQ	1.03	1.03	ND	ND	ND	ND	4.6
CPT-18D	86-MW18D	3/24/95	ND	ND	ND	BLQ	BLQ	ND	BLQ	BLQ	ND	ND	ND	ND	5.8
CPT-18DD	86-MW18DD	3/31/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.2
CPT-18S	86-MW18S	3/24/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4
MW-100	86-MW100	3/23/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	3.3
CPT-21D	86-MW21D	3/25/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA
CPT-21S	86-MW21S	3/25/95	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.9
MW-1[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-2[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-3[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-4[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-6[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-7[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-8[d]	-	5/95	140	85	270	NA	NA	NA	2450	2945	NA	NA	NA	NA	NA
MW-9[d]	-	5/95	37	ND	46	NA	NA	NA	ND	83	NA	NA	NA	NA	NA
MW-10[d]	-	5/95	180	ND	360	NA	NA	NA	220	760	NA	NA	NA	NA	NA
MW-11[d]	-	5/95	ND	ND	ND	NA	NA	NA	ND	ND	NA	NA	NA	NA	NA
MW-12[d]	-	5/95	210	ND	700	NA	NA	NA	2310	3220	NA	NA	NA	NA	NA

a/ BLQ = Below limit of quantitation, 1.0 µg/L.
b/ NA = Data not available or sample not analyzed for this parameter.
c/ ND = Compound not detected at the method detection limit.
d/ Sample collected and analyzed by CH2M Hill on May 10 and 11, 1995.



LEGEND

PPOL2-4	MONITORING WELL
SB-6	SOIL BOREHOLE
CPT-14 1108.3	CPT AND GROUNDWATER MONITORING POINT LOCATION, WITH TOTAL BTEX CONCENTRATION ($\mu g/L$) (MARCH 1994)
	UNDERGROUND MOGAS STORAGE TANK
	ABOVEGROUND WASTE OIL STORAGE TANK
—100—	LINE OF EQUAL TOTAL BTEX CONCENTRATION ($\mu g/L$)
	VEGETATION

CONTOUR INTERVAL = VARIABLE

NOTES:

1. ALL TANK AND WELL LOCATIONS ARE APPROXIMATE.
2. "B" INDICATES CONCENTRATION BELOW QUANTITATION LIMIT (1 $\mu g/L$).
3. DISPLAYED BTEX CONCENTRATIONS ARE MAXIMUM CONCENTRATIONS DETECTED AT EACH LOCATION.

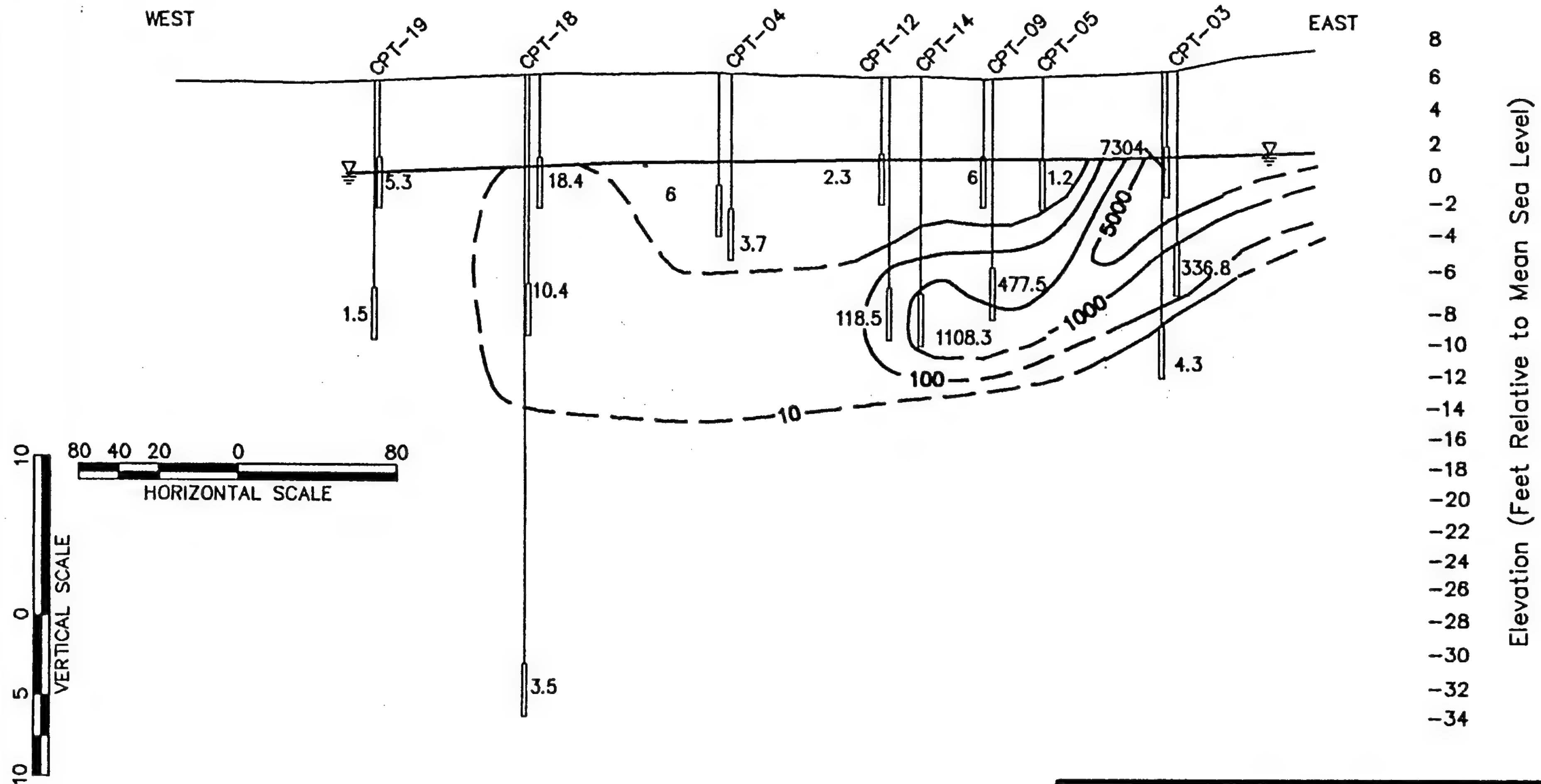
FIGURE 4.2

TOTAL BTEX ISOPLETH MAP FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1195, 08/10/95 at 11:00



LEGEND

APPROXIMATE GROUNDWATER SURFACE

3.756 WELL OR MONITORING POINT, WITH SCREENED INTERVAL AND TOTAL BTEX CONCENTRATION (μg/L)

—10— LINE OF EQUAL TOTAL BTEX CONCENTRATION (μg/L) (DASHED WHERE INFERRED)

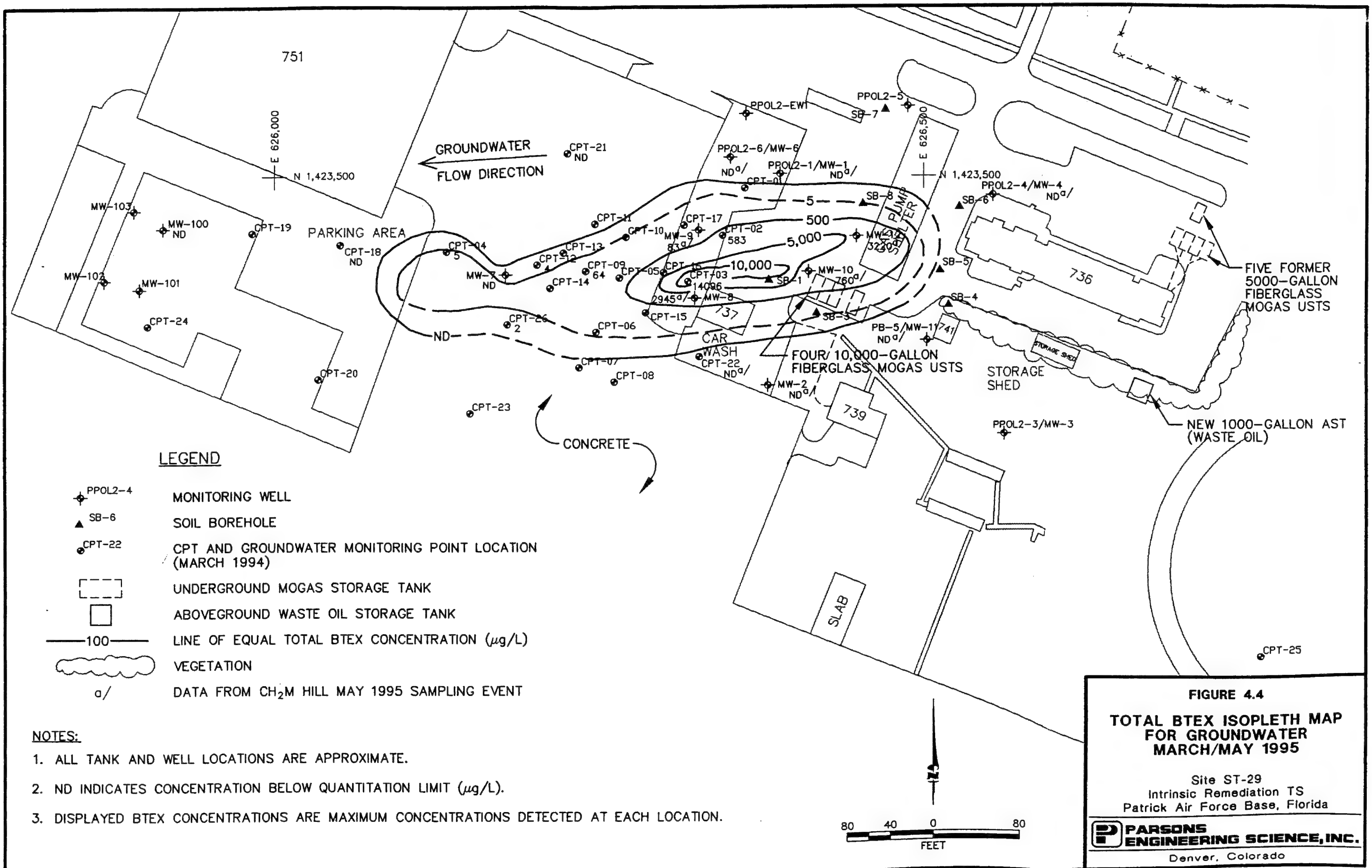
FIGURE 4.3

VERTICAL PROFILE OF TOTAL BTEX ISOPLETHS FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1201, 08/10/95 at 13:15



LEGEND

PPOL2-4	MONITORING WELL
SB-6	SOIL BOREHOLE
CPT-22	CPT AND GROUNDWATER MONITORING POINT LOCATION (MARCH 1994)
	UNDERGROUND MOGAS STORAGE TANK
	ABOVEGROUND WASTE OIL STORAGE TANK
100	LINE OF EQUAL TOTAL BTEX CONCENTRATION ($\mu g/L$)
	VEGETATION
a/	DATA FROM CH_2M HILL MAY 1995 SAMPLING EVENT

NOTES:

1. ALL TANK AND WELL LOCATIONS ARE APPROXIMATE.
2. ND INDICATES CONCENTRATION BELOW QUANTITATION LIMIT ($\mu g/L$).
3. DISPLAYED BTEX CONCENTRATIONS ARE MAXIMUM CONCENTRATIONS DETECTED AT EACH LOCATION.

FIGURE 4.4

TOTAL BTEX ISOPLETH MAP FOR GROUNDWATER MARCH/MAY 1995

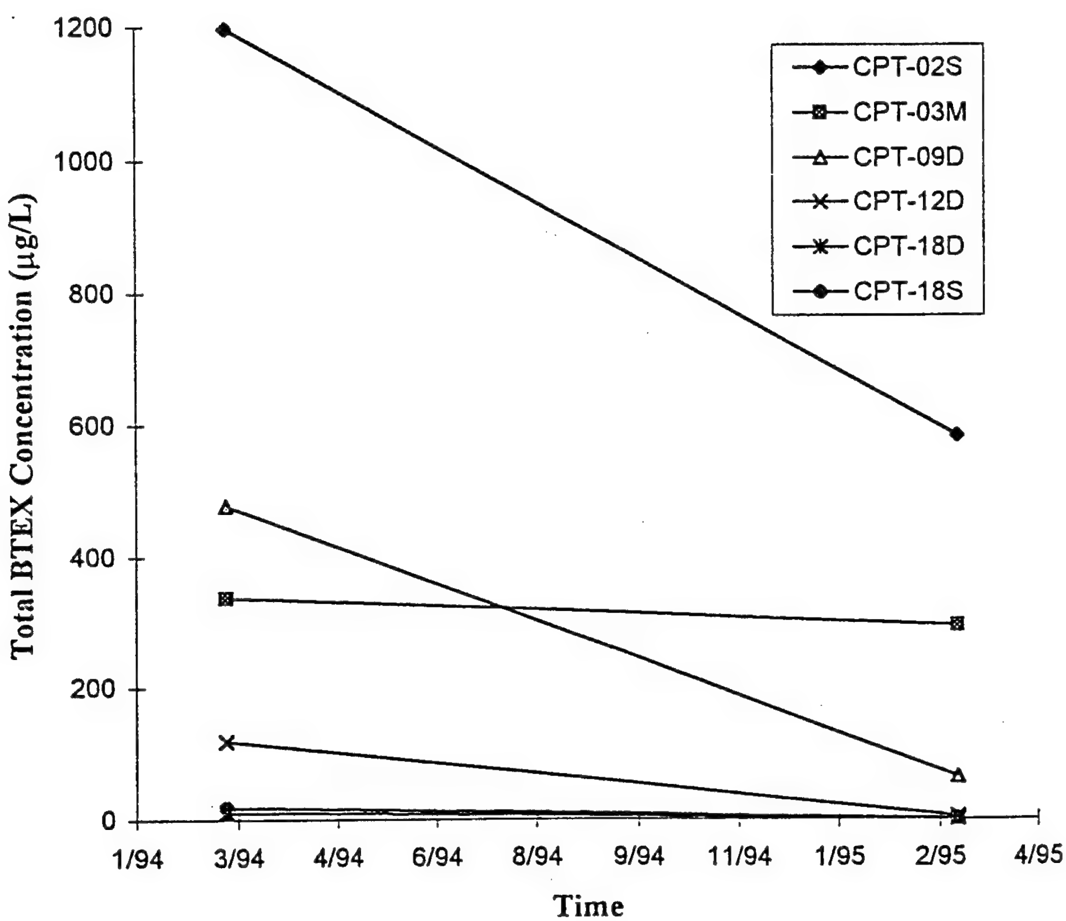
Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1187, 08/10/95 at 13:15

FIGURE 4.5A

PLOT OF TOTAL BTEX VERSUS TIME FOR SAMPLING LOCATIONS
WITH DECREASING BTEX CONCENTRATIONS
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA



C:\Z\45005\TABLES\FIG5A.XLS

FIGURE 4.5B

PLOT OF TOTAL BTEX VERSUS TIME FOR SAMPLING LOCATIONS WITH INCREASING BTEX CONCENTRATIONS SITE ST-29 INTRINSIC REMEDIATION TS PATRICK AFB, FLORIDA

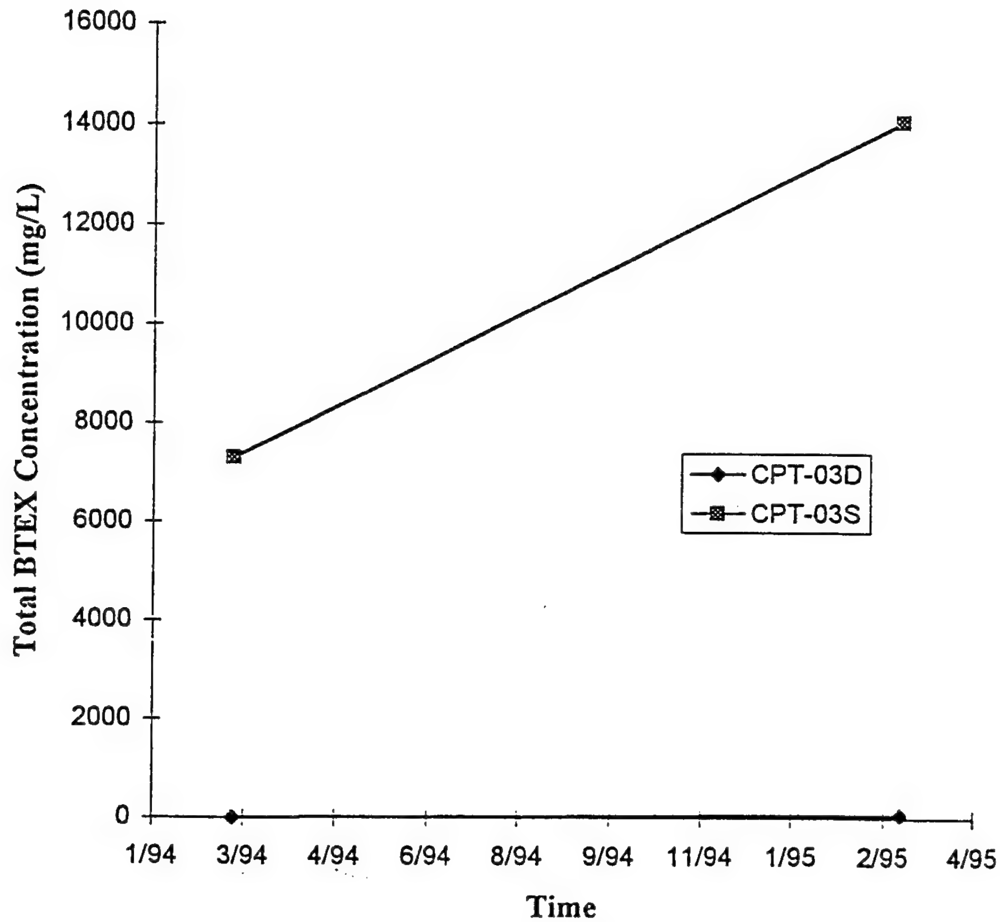


TABLE 4.5

GROUNDWATER GEOCHEMICAL DATA, MARCH 1994
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA

Sample Location	Sample Number	Water Temp. (°C)	pH	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/L)	Redox Potential (mV)	Total Alkalinity (mg/L)	Hydrogen Sulfide (mg/L)	Ferrous Iron (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	NO_2+NO_3 Nitrogen (mg/L)	TOC [a] (mg/L)	Methane (mg/L)
CPT-01	CPT-86-001	24.7	NA [b]	NA	0.4	NA	NA	NA	NA	44.4	4.37	0.13	14	4.99
CPT-02D	CPT-86-002D	24.7	7.1	771	0.6	-190	330	0.4	0.4	45.7	ND2 [c]	0.13	6.8	5.953
CPT-02S	CPT-86-002S	24.7	6.7	1061	0.2	-156	498	0.2	1.6	42.6	ND2	0.12	16.9	14.953
CPT-03D	CPT-86-003D	NA	7.3	721	NA	-255	315	1	0.4	41.6	ND2	0.12	5.4	1.63
CPT-03M	CPT-86-003M	26.4	7.1	898	0.2	-50	398	0	0.3	40.7	2.52	0.11	10.9	3.164
CPT-03S	CPT-86-003S	26.4	6.7	1733	0.1	-208	520	0.1	1.2	132	118	14.8	63.1	14.021
CPT-04D	CPT-86-004D	26.1	7.2	457	0.2	-266	212	0.2	0.6	12.4	1.47	0.09	5.6	3.756
CPT-04S	CPT-86-004S	26.9	6.9	469	0.3	-286	215	0.5	0.6	12.5	ND2	0.19	6.6	7.661
CPT-05S	CPT-86-005S	26.4	7.3	488	1.1	-160	215	0.1	0.1	23.6	6.86	0.17	12	4.858
CPT-06S	CPT-86-006S	25.1	7.6	437	0.2	-278	148	1.5	0.3	47.8	7.03	0.13	3.8	6.595
CPT-07S	CPT-86-007S	25.3	7.2	577	0.2	-250	254	1.2	1	30.2	2.52	0.12	3.4	6.339
CPT-08S	CPT-86-008S	25	7.1	974	0.2	-60	420	0	1.9	44.7	8.51	0.1	10.1	1.742
CPT-09D	CPT-86-009D	27.8	7.1	938	0.3	-200	422	0.6	0.2	34.7	15.3	0.11	12	4.236
CPT-09S	CPT-86-009S	27.3	7.3	530	0.2	-24	340	0	0.2	14.3	6.64	0.1	10.2	3.797
CPT-10S	CPT-86-010S	26	7.3	460	0.1	-60	192	0	0.2	26.6	9.5	0.13	21.3	3.493
CPT-11S	CPT-86-011S	25.9	7.2	508	0.1	-35	210	0	0.4	12.7	15.9	0.15	NA	4.244
CPT-12D	CPT-86-012D	27.1	7.2	715	0.4	10	329	0.1	0.1	28.1	3.86	0.12	8.1	0.983
CPT-12S	CPT-86-012S	27.3	7	564	0.9	30	266	0	0.1	15.2	8.38	0.1	10.5	5.372
CPT-13S	CPT-86-013S	25.7	7.3	801	0.1	-230	362	0.6	0.3	35.5	6.94	0.12	7.2	2.043
CPT-14D	CPT-86-014D	25.5	7	906	0.3	-240	460	0.6	0.3	34.6	3.68	0.11	12.8	8.793
CPT-16DD	CPT-86-016DD	26.7	NA	NA	2.7	NA	NA	0.3	NA	NA	NA	NA	NA	NA
CPT-16S	CPT-86-016S	25.5	7	776	0.1	-190	231	0.1	0.4	37.9	8.23	0.13	9.4	0.781
CPT-18D	CPT-86-018D	26.1	7.1	620	0.3	-60	294	0.2	0.3	15	1.85	0.11	5.6	4.56
CPT-18DD	CPT-86-018DD	27.3	NA	NA	2.3	NA	NA	0	NA	NA	NA	NA	NA	NA
CPT-18S	CPT-86-018S	26.6	6.9	834	2	25	286	0	0.5	36.6	86	0.12	7.8	NA
CPT-19D	CPT-86-019D	26.6	7.1	744	0.2	-50	328	0.2	0.2	33.7	1.51	0.1	7.3	2.136
CPT-19S	CPT-86-019S	NA	7	800	NA	41	335	0	0.1	37.4	8.85	0.11	10.3	0.924
CPT-20D	CPT-86-020D	25.7	7.1	842	0.3	-44	380	0.1	0.2	52	ND2	0.07	8.6	1.114
CPT-20S	CPT-86-020S	25	7	368	1.5	23	148	0	0.3	9.83	25.5	0.1	3.6	1.278
CPT-21D	CPT-86-021D	26.4	7.2	716	0.2	-20	304	0.1	0.2	29.8	13.3	0.14	6.1	0.46
CPT-21S	CPT-86-021S	26	7.1	610	3.2	20	245	0	0.2	26.6	25.5	[illegible]	7.6	2.414
CPT-22D	CPT-86-022D	25.4	6.9	936	0.1	-287	415	5	0.2	NA	NA	0.12	11.4	0.866

TABLE 4.5 (CONCLUDED)

GROUNDWATER GEOCHEMICAL DATA, MARCH 1994
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA

Sample Location	Sample Number	Water Temp. (°C)	pH	Conductivity (μmhos/cm)	Dissolved Oxygen (mg/L)	Redox Potential (mV)	Total Alkalinity (mg/L)	Hydrogen Sulfide (mg/L)	Ferrous Iron (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	NO_2+NO_3 Nitrogen (mg/L)	TOC[a] (mg/L)	Methane (mg/L)
CPT-22S	CPT-86-022S	25.5	6.8	1271	0.3	-153	450	0	1.2	66.6	128	0.07	10	3.218
CPT-23D	CPT-86-023D	26.7	7.1	779	0.4	-167	332	0.2	0.2	36.1	1.49	0.1	8.2	2.282
CPT-23S	CPT-86-023S	26.5	6.9	757	3.5	54	346	0	0.2	23.4	ND2	0.12	6.4	1.992
CPT-24D	CPT-86-024D	26	7.5	376	0.3	-60	192	0.1	0.1	5.46	3.61	0.1	2.8	0.686
CPT-24S	CPT-86-024S	25.7	7	358	1.7	30	190	0	0.1	6.63	ND2	0.12	5.6	2.204
CPT-25D	CPT-86-025D	NA	7.1	892	NA	62	371	0	ND1[d]	54.7	6.16	0.12	15.7	1.556
CPT-25S	CPT-86-025S	25	7.3	664	3.7	53	157	0	ND1	28	51.9	0.12	15.7	0.147
CPT-26D	CPT-86-026D	26.2	7	751	0.2	-293	311	3	0.4	44.9	19.8	0.11	8.3	2.961
CPT-26S	CPT-86-026S	26	7.6	558	2.2	-20	264	0	0.3	15.1	1.22	0.12	5	3.569
MW-100	CPT-86-100	25.9	7.2	607	0.5	-241	331	0.2	0.1	24.9	16.3	0.12	18.6	2.821
MW-101	CPT-86-101	26.5	7.2	533	0.3	-247	287	0.8	0.1	21.6	5.75	0.13	9	2.308
MW-102	CPT-86-102	25.8	7.2	523	0.2	-281	250	0.5	0.1	17.9	3.51	0.12	7.6	3.256
MW-103	CPT-86-103	25.4	7.4	445	0.1	-271	209	1	0.1	12.5	4.69	0.11	2.6	5.291
PB5	CPT-86-PB5	24.9	7.1	743	0.2	-140	291	NA	ND1	51.4	4.45	0.1	NA	4.414
PPOL2-1	CPT-86-PPOL2-1	26.3	7.1	747	0.1	-220	305	0.7	0.6	44	3.2	ND1	NA	5.33
PPOL2-6	CPT-86-PPOL2-6	27.2	7	30100	0.2	-230	334	0.8	NA	10200	1150	ND1	NA	0.034

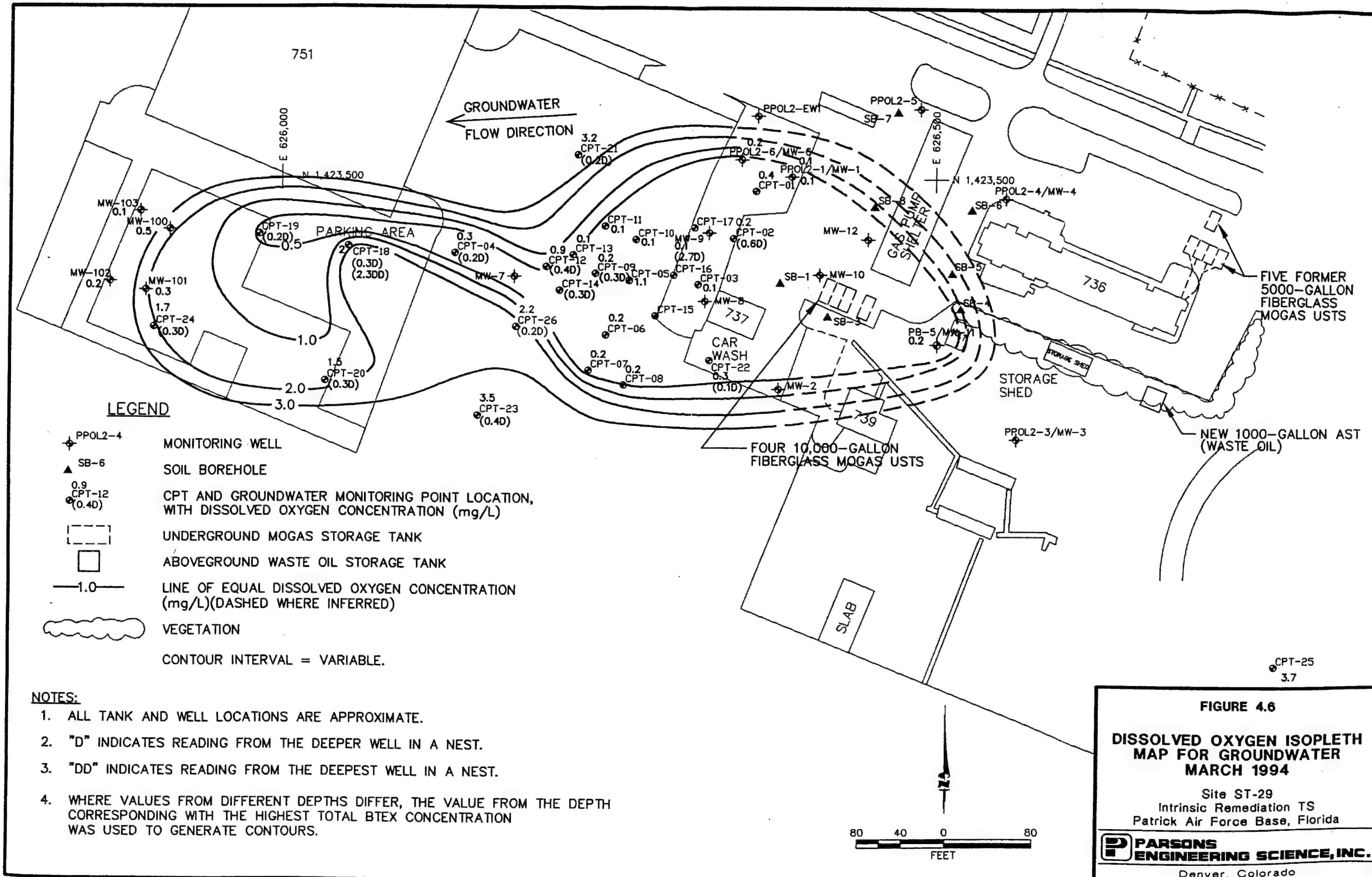
[a] TOC = Total organic carbon.
[b] NA = Not available.
[c] ND2 = <0.5 mg/L.
[d] ND1 = <0.05 m/L.

TABLE 4.6

GROUNDWATER GEOCHEMICAL DATA, MARCH 1995
SITE ST-29 INTRINSIC REMEDIATION TS
PATRICK AFB, FLORIDA

Sample Location	Sample Number	Sample Date	pH	Conductivity (µs/cm)	Redox (mv)	Alkalinity (mg/L CaCO3)	Chloride (mg/L)	Dissolved Oxygen (mg/L)	Nitrate + Nitrite (mg/L)	Ammonia (mg/L)	Ferrous Iron (mg/L)	Manganese (mg/L)	Sulfate (mg/L)	Hydrogen Sulfide (mg/L)	Carbon Dioxide (mg/L)	Methane (mg/L)
CPT-02S	2S	3/23/95	6.54	998	-231	404	62.7	0.1	0.06	3.83	1.1	<0.1	1.13	NA[a]	420	12.846
CPT-02S	2S DUP	3/23/95	6.53	995	-225	407	67.7	0.1	0.07	3.79	1.1	<0.1	1.08	NA	416	14.15
CPT-03D	3D	3/23/95	7.02	787	-348	341	46.5	0.1	0.08	1.18	<0.05	<0.1	15.7	5	144	2.57
CPT-03D	3D DUP	3/23/95	7.04	786	-347	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CPT-03M	3M	3/23/95	6.77	1019	-343	447	42.6	<0.1	0.06	6.13	<0.05	<0.1	19.6	NA	338	12.437
CPT-03S	3S	3/23/95	6.72	2010	-357	920	129	<0.1	<0.05	18.2	0.1	<0.1	14	NA	780	15.534
CPT-09D	9D	3/25/95	6.78	995	-293	469	51.1	0.1	0.06	3.85	<0.05	<0.1	2.23	5	284	9.839
CPT-09S	9S	3/25/95	7.38	391	-279	180	9.46	0.1	0.07	1.71	0.1	<0.1	1.52	1	80	5.822
CPT-12D	12D	3/25/95	6.93	946	-340	359	56.9	<0.1	0.05	2.37	<0.05	<0.1	49.7	5	202	0.882
CPT-12S	12S	3/25/95	7.05	498	-306	220	14.4	<0.1	0.07	4.04	0.3	<0.1	0.98	1	142	12.339
CPT-26D	26D	3/26/95	6.88	837	-342	357	51.2	0.1	0.06	2.61	<0.05	<0.1	3.31	5	192	3.756
CPT-26S	26S	3/26/95	6.87	440	-269	202	13.2	0.1	0.07	1.01	0.3	<0.1	0.94	0.7	154	9.009
CPT-04D	86-4D	3/25/95	7.04	540	-325	259	18.4	<0.1	0.07	2.53	0.1	<0.1	2.98	5	90	5.095
CPT-04S	86-4S	3/23/95	6.85	543	-289	263	15.8	0.1	0.07	3.6	0.1	<0.1	1.17	1	138	11.63
CPT-04S	86-4S DUP	3/23/95	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10.594
CPT-16DD	86-16DD	3/31/95	7.13	26900	-288	307	9830	0.1	<0.05	16.9	<0.05	<0.1	1200	NA	238	0.074
CPT-18D	86-MW18D	3/24/95	6.87	652	-316	289	29.6	0.1	0.07	1.52	0.1	<0.1	1.08	2	98	6.116
CPT-18DD	86-MW18DD	3/31/95	7.19	26500	-171	335	9080	0.2	<0.05	16.2	0.1	<0.1	967	<0.1	276	0.068
CPT-18S	86-MW18S	3/24/95	6.85	675	-287	276	18.3	0.1	0.07	0.35	0.2	<0.1	59.6	0.7	110	3.379
MW-100	86-MW100	3/23/95	7.32	429	-253	205	15.2	<0.1	0.07	0.23	0.3	<0.1	10	0.3	132	NA
CPT-21D	86-MW21D	3/25/95	7.18	674	-307	287	28.2	<0.1	0.07	0.47	0.1	NA	38.8	5	96	0.749
CPT-21S	86-MW21S	3/25/95	6.92	381	-239	177	12.3	0.1	0.08	2.94	0.6	NA	0.52	0.7	190	9.857

a/ NA = Data not available.



LEGEND

PPOL2-4	MONITORING WELL
SB-6	SOIL BOREHOLE
0.9 CPT-12 (0.4D)	CPT AND GROUNDWATER MONITORING POINT LOCATION, WITH DISSOLVED OXYGEN CONCENTRATION (mg/L)
	UNDERGROUND MOGAS STORAGE TANK
	ABOVEGROUND WASTE OIL STORAGE TANK
—1.0—	LINE OF EQUAL DISSOLVED OXYGEN CONCENTRATION (mg/L)(DASHED WHERE INFERRED)
	VEGETATION

CONTOUR INTERVAL = VARIABLE.

NOTES:

1. ALL TANK AND WELL LOCATIONS ARE APPROXIMATE.
2. "D" INDICATES READING FROM THE DEEPER WELL IN A NEST.
3. "DD" INDICATES READING FROM THE DEEPEST WELL IN A NEST.
4. WHERE VALUES FROM DIFFERENT DEPTHS DIFFER, THE VALUE FROM THE DEPTH CORRESPONDING WITH THE HIGHEST TOTAL BTEX CONCENTRATION WAS USED TO GENERATE CONTOURS.

FIGURE 4.6

DISSOLVED OXYGEN ISOPLETH MAP FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1196, 08/10/95 at 11:00

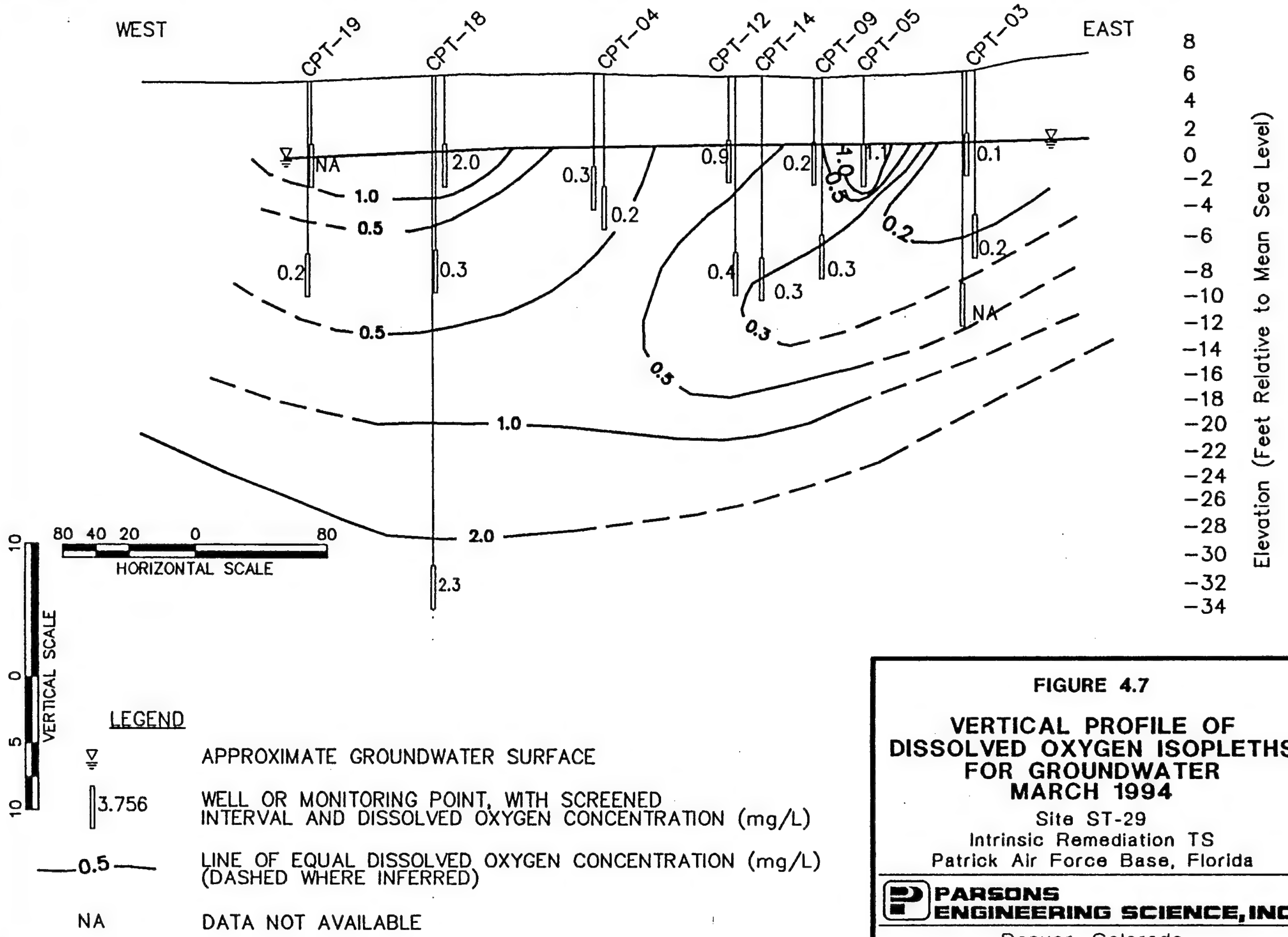


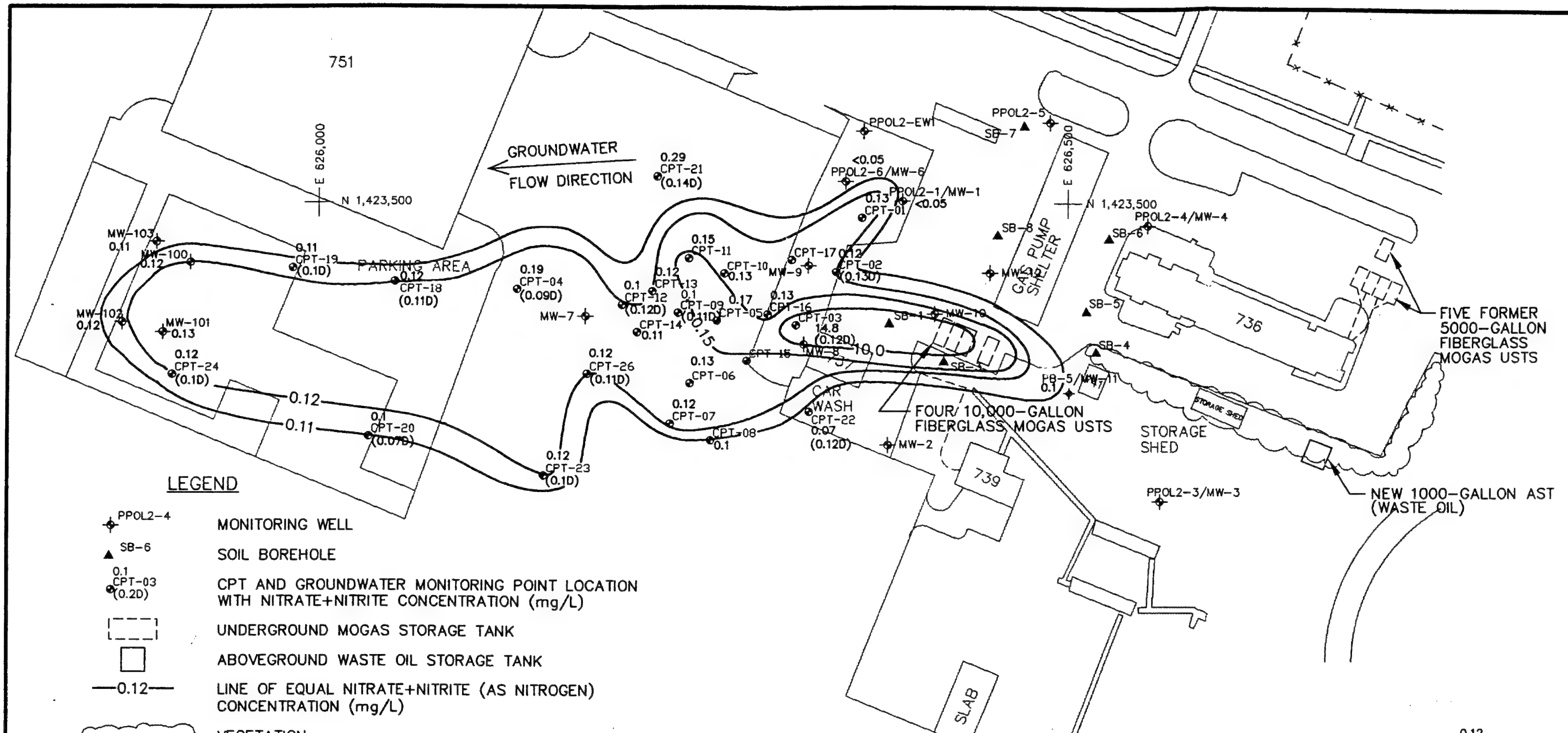
FIGURE 4.7

VERTICAL PROFILE OF DISSOLVED OXYGEN ISOPLETHS FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1202, 08/10/95 at 13:30



LEGEND

- MONITORING WELL (PPOL2–4)
- SOIL BOREHOLE (SB–6)
- CPT AND GROUNDWATER MONITORING POINT LOCATION WITH NITRATE+NITRITE CONCENTRATION (mg/L) (0.1 CPT–03 (0.2D))
- UNDERGROUND MOGAS STORAGE TANK
- ABOVEGROUND WASTE OIL STORAGE TANK
- —0.12— LINE OF EQUAL NITRATE+NITRITE (AS NITROGEN) CONCENTRATION (mg/L)
- VEGETATION

CONTOUR INTERVAL = VARIABLE.

NOTES:

1. ALL TANK AND WELL LOCATIONS ARE APPROXIMATE.
2. "D" INDICATES READING FROM THE DEEPER WELL IN A NEST.
3. WHERE VALUES FROM DIFFERENT DEPTHS DIFFER, THE VALUE FROM THE DEPTH CORRESPONDING WITH THE HIGHEST TOTAL BTEX CONCENTRATION WAS USED TO GENERATE CONTOURS.

FIGURE 4.8

NITRATE+NITRITE (AS NITROGEN) ISOPLETH MAP FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1197, 08/10/95 at 11:30

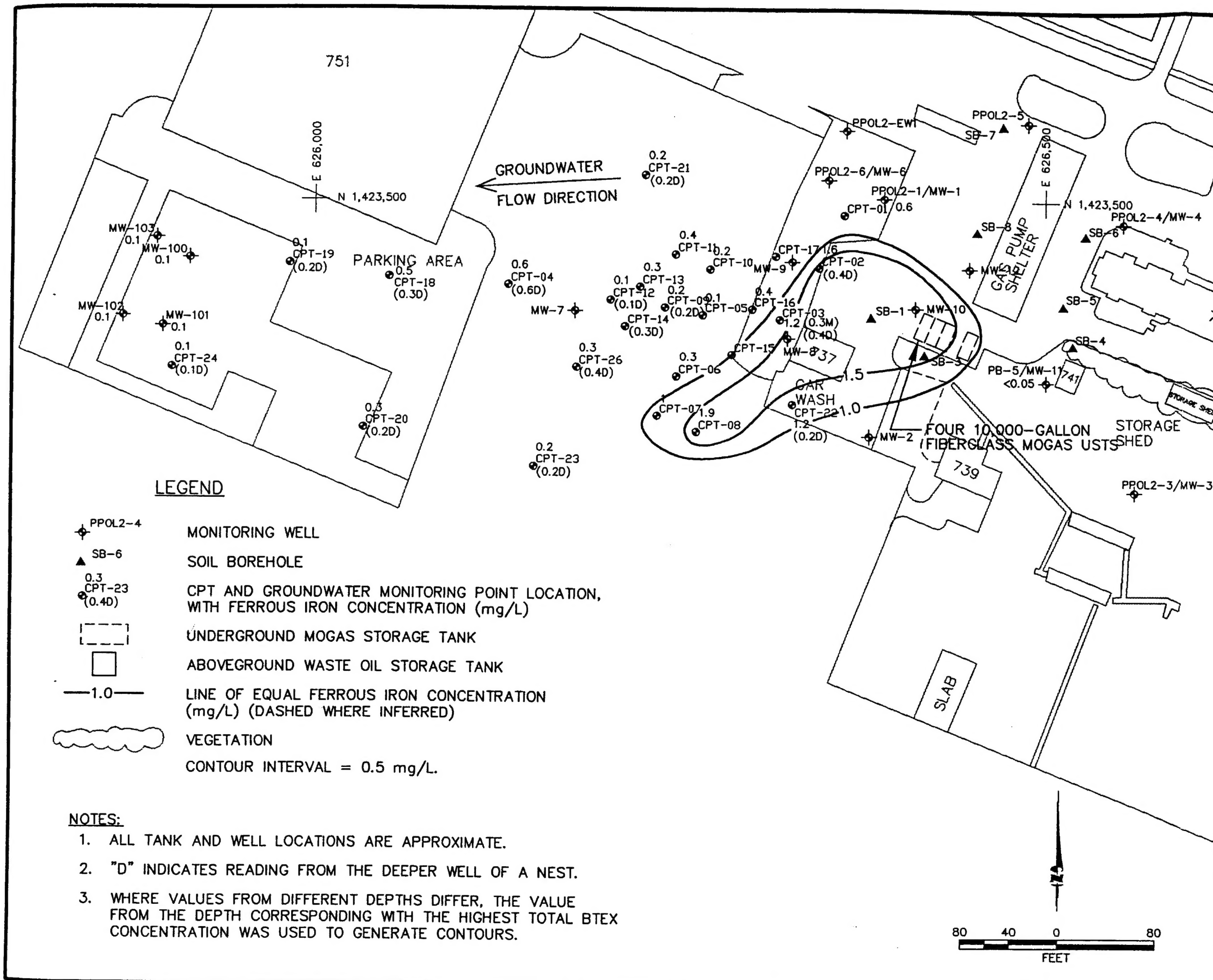


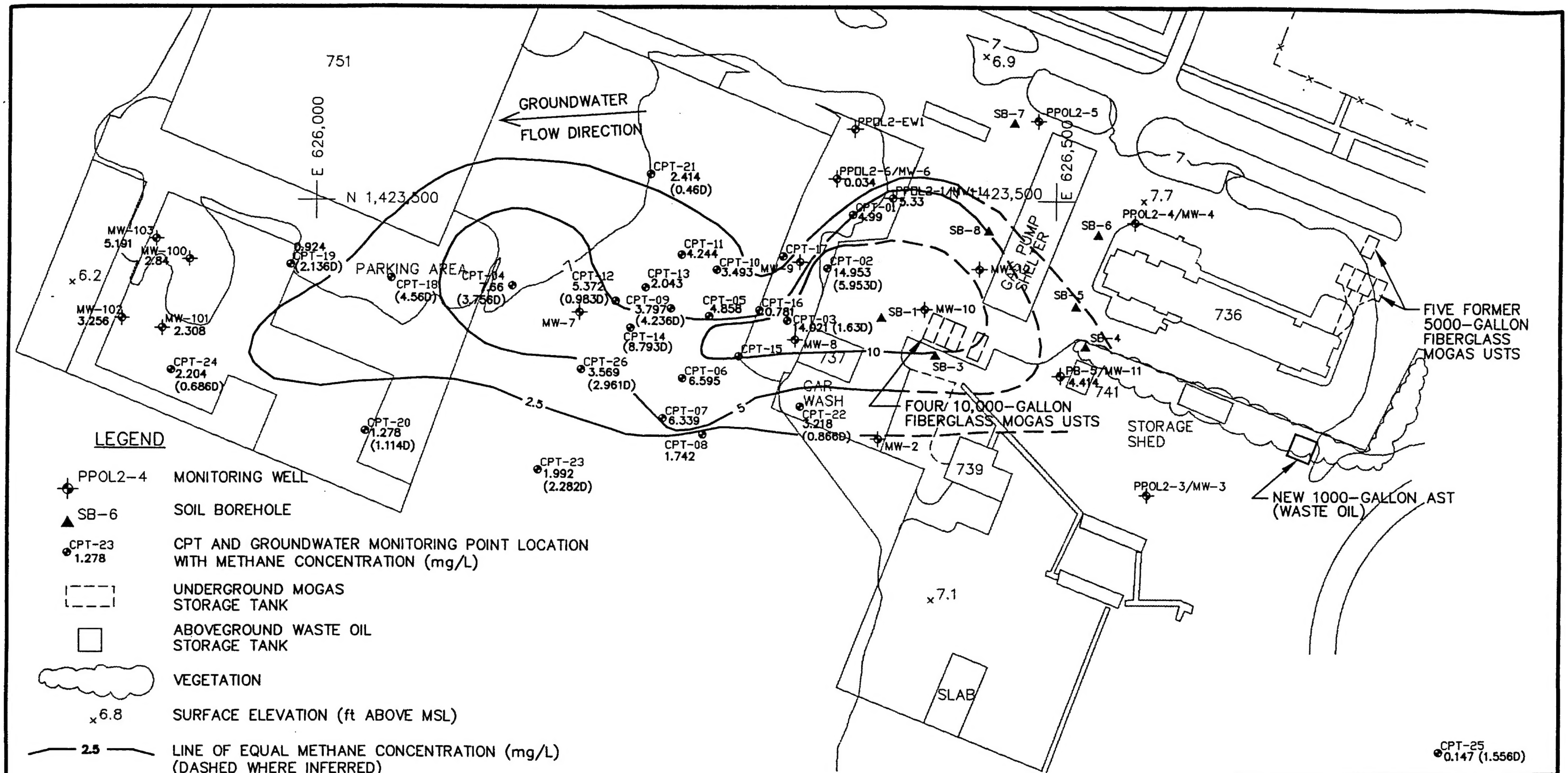
FIGURE 4.9

FERROUS IRON ISOPLETH MAP FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1198, 08/10/95 at 12:15



LEGEND

PPOL2-4	MONITORING WELL
SB-6	SOIL BOREHOLE
CPT-23 1.278	CPT AND GROUNDWATER MONITORING POINT LOCATION WITH METHANE CONCENTRATION (mg/L)
	UNDERGROUND MOGAS STORAGE TANK
	ABOVEGROUND WASTE OIL STORAGE TANK
	VEGETATION
x 6.8	SURFACE ELEVATION (ft ABOVE MSL)
2.5	LINE OF EQUAL METHANE CONCENTRATION (mg/L) (DASHED WHERE INFERRED)
	CONTOUR INTERVAL = VARIABLE

NOTES

1. ALL TANK AND WELL LOCATIONS ARE APPROXIMATE.
2. "D" INDICATES READING FROM DEEPER WELL OF A NEST.
3. WHERE VALUES FROM DIFFERENT DEPTHS DIFFER, THE FROM THE DEPTH VALUE CORRESPONDING WITH THE HIGHEST TOTAL BTEX CONCENTRATION WAS USED TO GENERATE CONTOURS.

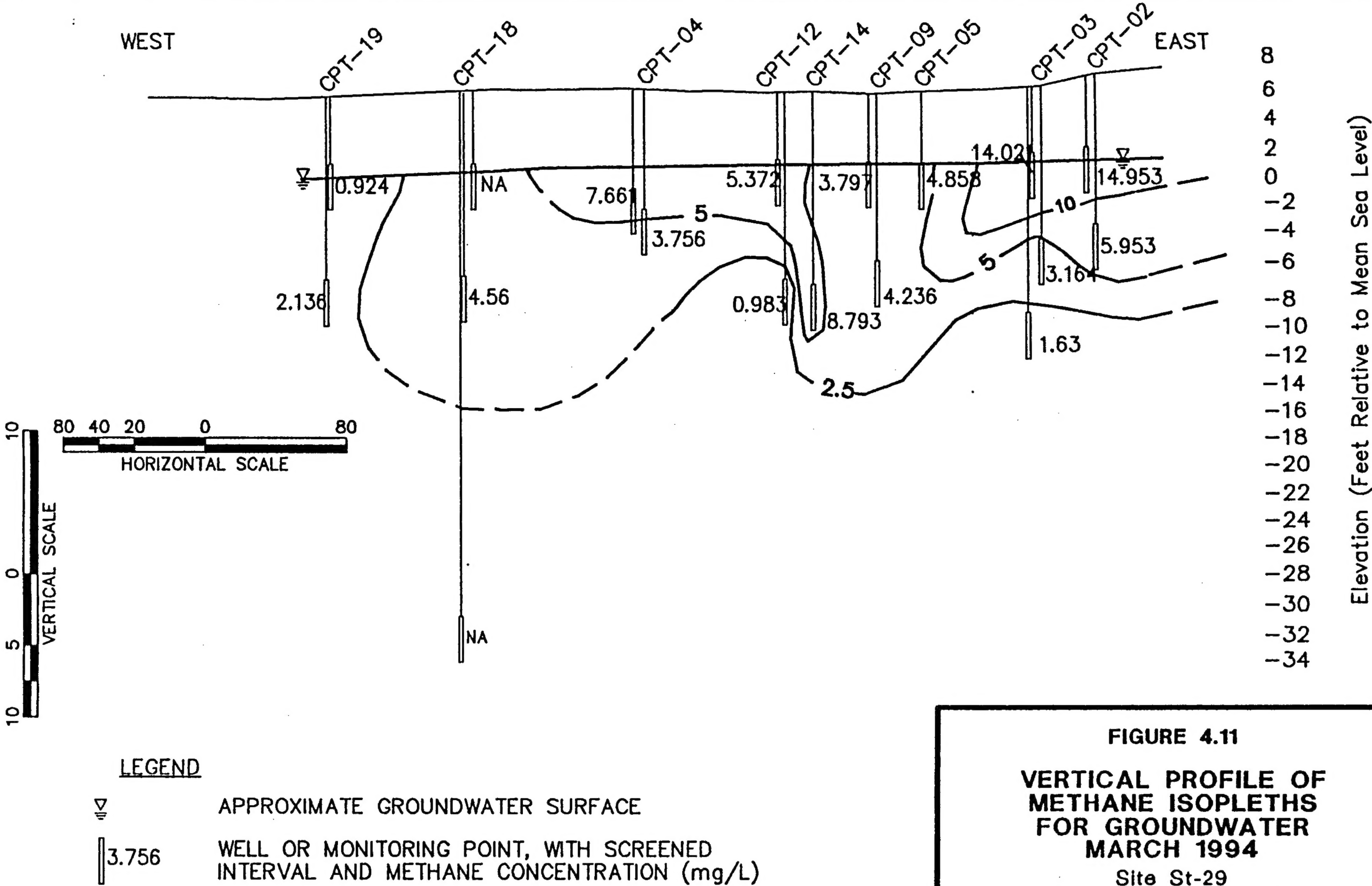
FIGURE 4.10

METHANE ISOPLETH MAP FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1199, 08/10/95 at 12:30



LEGEND

APPROXIMATE GROUNDWATER SURFACE

3.756 WELL OR MONITORING POINT, WITH SCREENED INTERVAL AND METHANE CONCENTRATION (mg/L)

NA DATA NOT AVAILABLE

5 LINE OF EQUAL METHANE CONCENTRATION (mg/L) (DASHED WHERE INFERRED)

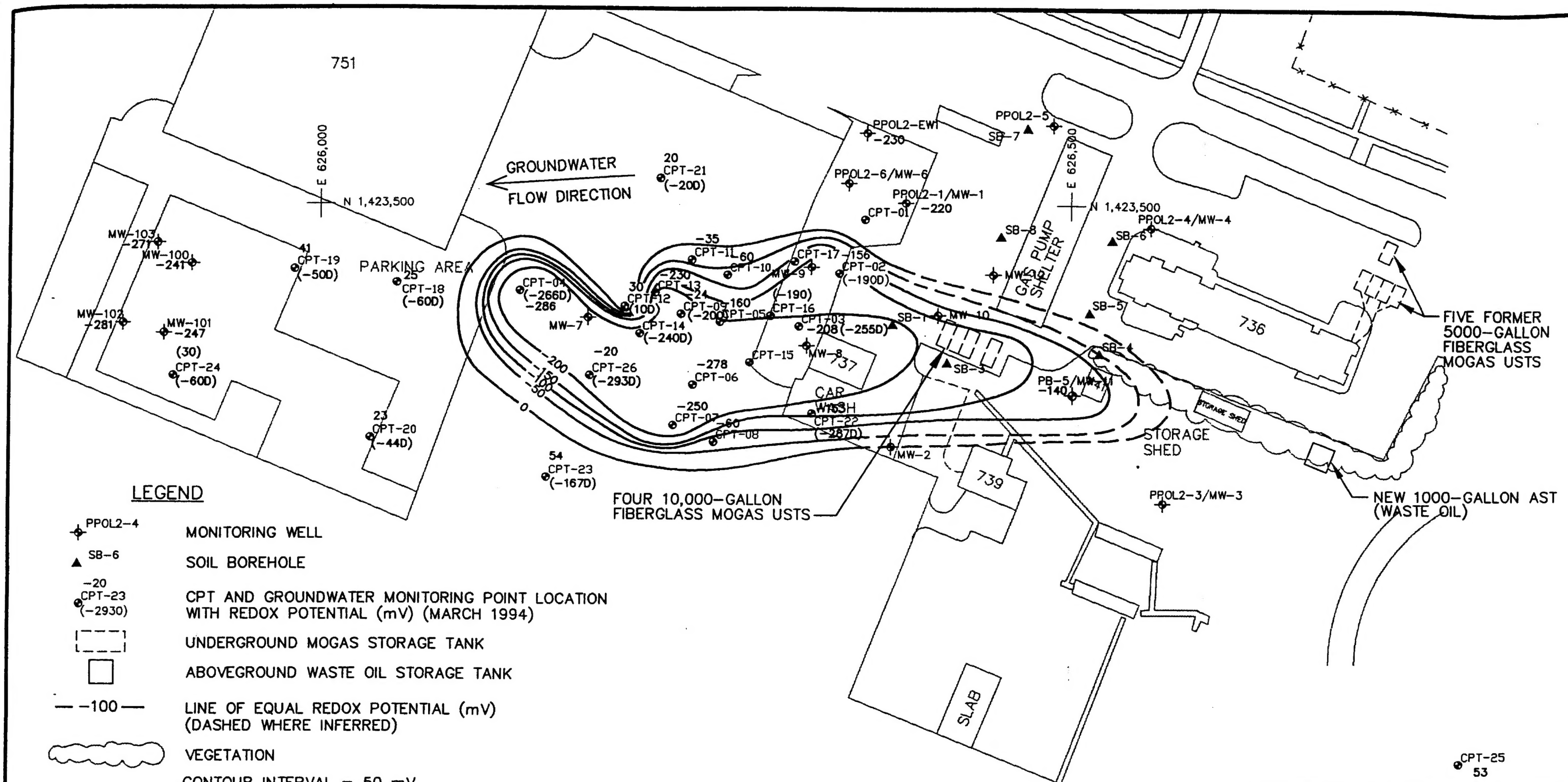
FIGURE 4.11

VERTICAL PROFILE OF METHANE ISOPLETHS FOR GROUNDWATER MARCH 1994

Site St-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1203, 08/10/95 at 13:30



LEGEND

PPOL2-4	MONITORING WELL
SB-6	SOIL BOREHOLE
-20 CPT-23 (-293D)	CPT AND GROUNDWATER MONITORING POINT LOCATION WITH REDOX POTENTIAL (mV) (MARCH 1994)
	UNDERGROUND MOGAS STORAGE TANK
	ABOVEGROUND WASTE OIL STORAGE TANK
-100	LINE OF EQUAL REDOX POTENTIAL (mV) (DASHED WHERE INFERRED)
	VEGETATION
	CONTOUR INTERVAL = 50 mV.

NOTES:

1. ALL TANK AND WELL LOCATIONS ARE APPROXIMATE.
2. "D" INDICATES READING FROM THE DEEP WELL IN A NEST.
3. WHERE VALUES FROM DIFFERENT DEPTHS DIFFER, THE VALUE FROM THE DEPTH CORRESPONDING WITH THE HIGHEST TOTAL BTEX CONCENTRATION WAS USED TO GENERATE CONTOURS.

FIGURE 4.12

REDOX POTENTIAL MAP FOR GROUNDWATER MARCH 1994

Site ST-29
Intrinsic Remediation TS
Patrick Air Force Base, Florida

PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

95DN1200, 08/10/95 at 13:00